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Market Power and Its Sources in the Food Industry[*]

G. E. BRANDOW

Market power is defined in terms of a firm's ability to affect directly other participants in the market or such market variables as prices and promotion practices. The article distinguishes between short-run and long-run power and between offensive and defensive power. More than a dozen sources of power are identified in the food industry. Some of the things commonly regarded as manifestations of market power are unreliable indicators of it. In particular, higher-than-average profits and market power do not necessarily go together.

MARKET power is one of the most elusive terms in economics. Many economists avoid its use, apparently regarding it as lacking in precision or, in the extreme case, lacking any real meaning. Some economists use it interchangeably with "monopoly," "market control," etc., without defining any of the terms. If a single meaning can be extracted from recent literature, it is that market power means an element of monopoly in the sense that the firm possessing it is less constrained in its economic behavior than is a firm operating under pure or perfect competition.[1]

Kaysen and Turner explicitly state such a definition: "Where firms can persistently behave over substantial periods of time in a manner which differs from the behavior that the competitive market would impose on competitive firms facing similar cost and demand conditions, they can be identified as possessing market power" [6, p. 8].[2] Mason implies a similar meaning in his frequent parenthetical definitions, for example, ". . . the preservation of competition, meaning the exclusion of positions of market power . . ." and "Market power, that is to say, some protection from a competitive forcing of prices toward short-run marginal cost . . ." [7, pp. 92, 93].

The Kaysen and Turner definition has the disadvantages of defining market power by indirection, of using a logical construct rather than a real-world situation as its reference situation, and of dealing only with

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[1] This article does not deal directly with bargaining power, a topic of much current interest among farmers. A firm or group obviously needs some market power to bargain meaningfully, but market power may not be exercised through a bargaining process. K. R. Farrell makes a similar distinction [3].

[2] Kaysen and Turner refer to the perfect competition model. Pure competition as used in the present paper differs from perfect competition in not requiring perfect knowledge and factor mobility

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long-run power. It seems better to define market power directly, along the following lines: A firm may be said to possess market power if a price, production, marketing, or purchasing decision it might practically make can directly and materially affect the incomes of other firms or persons or can appreciably change the average price, total quantity, or marketing or purchasing practices in a market in which it participates. A firm with market power in selling can change its rivals' sales volumes if it substantially changes its prices or promotion activities, and hence can change its rivals' incomes, unless the rivals adopt counter measures; and in that case, market-wide prices or promotion practices will be altered, as a minimum. Analogous statements could be made about a firm with market power in purchasing materials or in hiring labor. If the firm has no market power in any respect, its customers, suppliers, and employees have enough alternatives so that they can avoid the unilateral action of the firm without significant loss to themselves.[3] In short, a firm with market power can make waves; a firm without market power cannot.

It is well-known, but worth repeating, that market power has many gradations ranging from none at all when the firm operates under strictly pure competition to great power when the firm has an unregulated monopoly in the sale of an important product with an inelastic demand (or a monopsony in the purchase of materials or the hiring of unorganized labor with inelastic supplies). A firm may have little or no power in one market but considerable power in another—for example, a canning company may have substantial power in the purchase of a certain vegetable in one growing area, very little power in selling the processed product in a private-label market, and only slight power in employing labor.[4]

Though the distinction is necessarily imprecise, a difference between short-run market power and long-run market power is important. Short-run power exists if the firm can materially affect the market or other participants in it over some short period of time—say, up to two or three years. Long-run power endures for more extended periods, as for a decade or more. A large fluid milk processor might be able to raise the into-store price in a particular metropolitan market for a year or two but then lose his power as smaller rivals expanded their plant capacity and undersold him, as new processors entered the market, or as large retailers vertically integrated into processing. If, however, the large processor could induce rivals to follow his price lead and new processors of all types were kept out of the market, perhaps by legal barriers, the firm would have long-run market power. The time ordinarily necessary for rivals to expand, for new firms to enter the market, and for other undermining developments to occur distinguishes the short run from the long run.

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[3] Legal restriction may also modify or to an extent re-direct market power available to a firm.

[4] Quantitative measures of the degree of market power are not easy to devise. Power differs for different purposes. As argued later, profit rates indicate market power only in certain instances. Market shares and concentration ratios indicate two important sources of market power but do not measure power itself.

A firm having substantial market power is likely to be circumspect in its use *if* the power appears to be short run only. Then, many of the short-term advantages it might gain would be more than offset by subsequent losses. Such a firm is in the position of being able to retain its short-run power over a period of years only it it uses the power with restraint. It has power to prevent short-run instability in its markets and to do well for itself in some temporary situations, but it should not adopt methods that would eventually bring new or expanded rivals into the market. A firm may, of course, misjudge its power or in fact have long-run power.[5]

The distinction between short-term and long-term power is instructive about the important but notoriously fuzzy concept of workable competition. Short-run power may contribute to good performance by stabilizing markets and by permitting innovations to be introduced under favorable circumstances, while long-run power that might reduce efficiency or progressiveness may be much less assured to firms and hence little abused. Thus, obvious departures from pure competition may fail to impair performance as predicted by standard theory. The short-run, long-run distinction also highlights the importance of conditions of entry into an industry as an influence on market power and performance there.

Another useful distinction is that between offensive and defensive market power. A firm may have substantial short-run market power and have large financial resources upon which to draw, yet the firm may judge that its long-run interests are best served by operating in a routine fashion. It is not likely to take the offensive against rivals, buyers, or suppliers in an effort to increase its profits or market share. But if another firm takes offensive action, the first firm will be able to adopt potent counter-strategies and to survive for a long time. The firm has more defensive than offensive market power.

Sources of Market Power

Review of the food industry suggests that market power can arise from several sources.[6] Most of the following discussion is in terms of selling but also applies to purchasing and to employment of labor. The principal sources of market power, not necessarily in order of importance, are:

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[5] Fellner distinguishes between the short run and the long run in discussing profit maximization. Although to him "the profit incentive is not typically a short-run incentive," he points out, among other things, that "the pricing problem is in a sense a short-run problem" and that "high profits may induce outsiders to take up competition" [4, pp. 158, 161].

[6] Observations are based largely on the work of the National Commission on Food Marketing, whose results were published in a final report [9] and in ten technical studies.

1. **Large size in relation to the relevant market.** The larger the firm's market share, the more its own prices, production, promotion, etc. contribute to market-wide aggregates and the greater will be the firm's ability to modify the market situations faced by others. Rivals are more compelled to follow a price reduction or adopt a promotional device initiated by a firm with a large market share, and they can more confidently follow such a firm's price increase in the expectation that it will hold. Of all sources of market power, this one—market share—is most often emphasized in economics literature and requires no elaboration here.

2. **Large financial resources.** Firms of equal size and market shares may differ in the extent to which they are financed by equity capital or have ready access to additional funds. The firm with the larger financial resources can better survive competitive battles or its own mistakes and can accept more risk in launching new ventures. Firms weak in this respect will not be inclined to oppose the strong firm and have an unequal chance of success if they do. An important means by which some firms have increased their strength from this source in recent years has been by becoming a subsidiary of a large and well-financed conglomerate. Financial resources are highly associated with market share, diversification, and vertical integration.

3. **Diversification over products.** In simple diversification, the firm produces several related products rather than one or only a few; in the more complex case, the firm is a conglomerate operating in several industries not closely related to each other. Diversification reduces the firm's dependence on any one product and increases its options in pursuing offensive or defensive tactics in a single market. This is especially true for the conglomerate, which may be able to engage in market share struggles in an industry without affecting the sources of most of its income. The assumption is made here, of course, that the firm does not gain diversification at the expense of efficiency.[7] Where this is true, rivals in any market are likely to recognize the greater strength of the diversified firm. The firm may also be able to avail itself of market-power benefits of the full-line seller over a limited-line firm, and tactics such as reciprocal dealing may give it special advantages.

4. **Geographic extension over local markets.** A firm operating in a number of independent local markets, e.g., a large food chain or bread baker, is much like a conglomerate in the sense that tactics it adopts offensively or defensively in one market need not seriously threaten its income or

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[7] Sometimes a highly specialized producer is more efficient in serving a part of the market than are conventional firms and thus can encroach on their business. This has been one of the reasons for the growth of jug milk operations, for example.

financial position. Comments about conglomerates in this regard apply to firms operating in several independent local or regional markets.

5. **Vertical integration.** The vertically integrated firm is diversified over successive stages of production and distribution rather than over products or local markets (though it may be diversified in those ways as well). The fortunes of the firm, therefore, are not tied exclusively to its performance of a single function, and it can call upon resources from other operations in power struggles in any market in which it nominally participates. For example, a flour milling firm that is integrated forward into the manufacture of such flour products as cake mixes and snacks is less vulnerable to severe price squeezes in milling than is a specialized miller.

A vertically integrated firm with a large market share at one stage may have opportunities to squeeze unintegrated rivals at other stages or to influence prices directly. Known examples in the food industry are few and are subject to conflicting interpretations.

6. **Membership in an oligopolistic core: concentration.** A large market share usually is one source of a powerful firm's influence. Frequently such a firm finds itself one of a small group of firms that collectively account for a large portion of the total market volume. The inescapable interdependence among the dominant firms in this case is a strong inducement for each to adopt pricing, marketing, and other practices tolerable to, if not preferred by, other group members. One firm's market power then depends on its influence in the group and on the group's influence in the total market. The strongest member of the group—and this may well depend on power sources other than market share—can strongly influence group behavior and thus enhance the firm's own power. A weaker member of the group usually will at least have veto power over group action. Each firm of the oligopoly core both gains something from being a member of the group and gives up some of its independence to the imperatives of group discipline. The existence of concentration in the market is not a simple addition to or subtraction from power gained from other sources by one of the leading firms, and it modifies the context in which any power can be exercised.

The oligopoly group may be strong or weak, depending on its market share, ease of entry by new firms or expansion by small ones, product differentiation, type of buyer, and still other circumstances, several of them discussed here as sources of power for individual firms.

7a. **Product differentiation, including new products.** The firm that succeeds in convincing numerous buyers that its particular product has some unique merit over others has in a sense established a new product over which it has complete monopoly. Ordinarily, however, the monopoly will be weak, for similar products sold by other firms will be close if not perfect substitutes in the minds of buyers. One of the most potent forms of product differentiation is a distinctly new product of genuine usefulness to large numbers of buyers; until other firms succeed in producing the same or similar product, the innovator has a strong monopoly.

Product differentiation in the food industry, however, usually takes the form of brands and "new" products that differ from others, if at all, only in minor respects. Promotion, mainly advertising, is the principal means of establishing strong impressions of unique merit. The resources and skill with which to promote products on a national or at least regional scale often are crucial to successful product differentiation and hence to this source of market power. Economies of size in promotion may be a more important influence on size of firm than is efficiency in physical operations [10, pp. 61–104].

7b. **Access to consumers.** This item is an important elaboration of the foregoing one. The expertness of buyers is crucial to the power to be gained from product differentiation by sellers. An industrial buyer of a material that will lose its identity in a manufactured product ordinarily will bring much technical knowledge to the task and may have considerable testing equipment at his disposal; only genuine and significant product differentiation will interest him. Frequently, moreover, he can express the quality characteristics he wants in technical terms and buy on specification, in which case the seller can claim no product differentiation.

Consumers, in contrast, are not expert buyers of most things they purchase, nor do they have the time or resources to act in expert fashion if they were. They are easily convinced—will even convince themselves—that product differences exist where none in fact do,[8] and they value prestige and change even where these are not related to intrinsic product quality. The comparative expertness of buyers makes a fundamental difference between consumer goods industries and producer goods industries with respect both to sources of market power and to several aspects of performance.

Both food manufacturers and retailers have access to consumers—manufacturers by advertising, couponing, etc., and retailers mainly by operating the stores where consumers shop. Farmers usually have no access to consumers, though some farm products are advertised and retain their identity when they reach consumers. The dairy industry provides an example of shifts in market power due to access to consumers: the decline of home delivery of milk and the shift to private label sales to food retailers probably have been important factors in the apparent decline of the market power of fluid milk dealers.

8. **Structure of buyers, especially their size and number.** Dealing with

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[8] In a controlled study, consumers were found to develop brand loyalties for products that were identical even though no advertising was used; amusing examples are given of consumers' confidence in their judgment [8].

large firms on the other side of the market tends to reduce a firm's market power. Since obtaining market outlets often is more limiting to firms' growth than are production problems, the volume represented by a single large buyer makes his business especially attractive to sellers capable of handling it. Once such a firm becomes a customer, loss of its business may be serious to the selling firm. Oligopsony among buyers tends to encourage them to present a united front to sellers. The large buyer has the ability to be a highly expert purchaser, to seek out the best deals available anywhere in a large procurement area, to develop his own brands, and often to integrate into the supply industry if the best possible terms are not offered. The rise in the importance of chains and wholesale buying groups has been a leading reason for the growing power of food retailers relatively to suppliers.

9. **Elasticity of demand for the industry's product.** The opportunity for an oligopoly group to influence selling prices can be great when demand for the industry's product is highly inelastic; the opportunity is necessarily small when demand is highly elastic. The same general idea applies to purchasing and to labor markets. The elasticity of demand facing any one of many firms will be greatly different from the elasticity of industry demand, but probably an inelastic industry demand favors the power of a firm with a large market share to influence price. The mutual interest of the firm and its principal rivals in maintaining prices at as high a level as long-term considerations—e.g., entry of new firms—permit will strengthen tendencies toward price leadership-followership behavior. This may be especially pronounced when costs are rising, for then higher prices do not necessarily increase profits and thereby attract new firms or encourage expansion by old ones.

10. **Operating efficiency, marketing effectiveness, and progressiveness.** When oligopolistic firms' market power derived from other sources is about equal, the firm with particularly low costs, outstanding ability to promote its products, or exceptional progressiveness in introducing new operating methods or products is likely to be granted a leadership role by its rivals. Operating efficiency will be especially important when products are not readily differentiated; the low-cost firm will have one of the lowest preferred prices of the oligopoly group and probably will be one of the first to limit price increases in the industry. Where product differentiation is high, the firm that promotes old products or introduces new ones especially effectively is likely to be the industry leader and may be able to obtain prices substantially higher than those at which run-of-the-mine firms can sell. The lesser firms follow the dominant firm by discounting their prices below its prices by rather standard amounts.

11. **Other sources of market power.** Some factors affecting market power may reduce or eliminate power that otherwise would exist. Chronic

excess capacity in a market, which may result from declining demand or from new availability of supplies from other areas, makes at least some firms especially eager to get extra business at almost any price exceeding direct costs. Cutthroat rivalry may develop, making it impossible for any firm to exercise much control over prices or marketing practices. A mild example on the purchasing side is the scramble for Class II milk by manufacturers in fluid milk markets when the supply is well below manufacturing capacity. Abnormally large inventories weaken a firm's position in a selling market, especially if the product is perishable; as the saying is in meat packing, "Sell it or smell it."

Firms may have market power conferred upon them by weakness, usually temporary, of those with whom they trade. For example, retailers are in a strong position if fluid milk dealers with excess capacity are desperate for sales, and processors of a farm product are likely to benefit from sudden increases in supplies. Patents have occasionally been the basis upon which market power originally was built, as in the case of the Kraft-Phenix Cheese Corporation [5, p. 49], but they are not now widely important in the food industry. Collusive, unfair, and deceptive practices are likely to add to market power as long as they go unchecked. Strong-arm tactics and underworld methods are not trivial.

Antitrust and related regulation have had substantial direct and indirect effects on structure and conduct in the food industry and thus on market power of firms.[9] Federal and state marketing orders have strengthened the power of several bargaining associations in fluid milk, fruit, and vegetable markets. Political influence exercised by large food firms, trade associations, and farm groups has supplemented economic power; in the case of large firms, the sources of political and market power have much in common.

Manifestations of Market Power

The definition of market power suggests the means by which it can be detected directly: by observing ways in which the firm having power affects prices, marketing, procurement, or hiring practices or, more commonly, induces reactions among other firms that lead to market-wide changes in such variables. Price leadership in selling or in purchasing is a common example in the food industry. The equivalent of price leadership is often seen in promotional activities. For example when one food chain in a local market adopts stamps or games, other leading retailers frequently adopt similar promotions. Or some retailers may go in another direction, price discounting, which is not followership but is nevertheless a reaction induced by the first firm.

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[9] Though antitrust regulation has in general tended to dilute market power, the effect has not been entirely one-way. For example, action against horizontal mergers probably has increased conglomerate mergers, and in some instances the Robinson-Patman Act may assist a seller in maintaining prices

Manufacturers may for a time refuse to sell private label products, thereby displaying power on their part, but then cave in when a chain shows its power by undertaking—or by seriously threatening to undertake—its own processing. Exchange arrangements between buyers and sellers, together with the context in which the arrangement is made, may reveal market power. As an example, contracts only one grow-out period long may seem to be equally risky to broiler integrators and to growers, but two facts indicate that the arrangement reflects superior market power by integrators: (1) potential supply expansion is large through entry of new growers and increased production by old ones, and (2) failure to renew a contract ordinarily is more damaging to the grower than to the integrator.

The ways in which market power may be exercised are many and subtle and may not be readily apparent to the outsider. Intimations from businessmen themselves are therefore informative. What rivals do they watch most closely; what customers do they service with greatest alacrity? The pecking order at a trade association meeting largely reflects industry opinion as to who has market power and who does not.

High profits are a common objective of the use of market power, though, as Galbraith and others have persuasively argued, other objectives also are important. Consistently high profits for a firm, however, are not necessarily proof of great market power. An unusually well-managed firm may make distinctly better-than-average profits under pure competition. A giant firm with great market power may no longer be a good performer or may be holding a price umbrella for much smaller but more profitable firms. No one would suppose that the profit rates of A & P and Weis Markets are indicative of the current market power of the two food chains—but he might see a hint for the future.[10]

High average profits for the oligopolistic group in an industry probably reflect market power unless caused by temporary conditions. Four breakfast cereal manufacturers, accounting for 85 percent of shipments, made 19.4 percent on net worth after taxes in 1964; food manufacturers as a whole earned an average of 9.8 percent that year [9, p. 67]. On the other hand, a group of large firms may have significant market power though not unusually high profits. The market power of food retailers has risen substantially in the past two decades or so and has been used to bring about numerous changes in market channels, suppliers' services, position of manufacturers' brands, and methods of vertical coordination from farm to retail store. Small, independent retailers could not have done these things. But power to influence the supply system has been available to some degree to most substantial retailers and group wholesalers. Rivalry among retailers has been keen enough to cause most of the potential gains from market power in relation to suppliers to be competed away[11]—partly in the form of higher promotion costs.

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[10] In the year most closely corresponding to calendar 1966, A & P, with 4,693 stores and sales of $5,475 million, earned 9.2 percent on net worth after taxes; Weis Markets, a Pennsylvania chain, had 55 stores, sales of $126 million, and profits of 21.7 percent. A & P was not the least profitable of the large chains, nor was Weis Markets the most profitable of the smaller chains [11, p. 22].

Farmers, who commonly sell under pure competition when prices are not fixed by government programs, often regard ability to quote a selling or buying price as evidence of market power. But many sellers or buyers with little market power quote prices. Usually, conventions have developed as to whether buyers or sellers quote prices, and the conventions appear to be based on efficiency and practicability. Retailers have more market power than their suppliers in some markets where sellers conventionally quote prices. A related notion is that if there are price takers there must be price makers, in the sense of setting prices. Both sides of a market may be purely competitive, however. Even where some degree of oligopoly or oligopsony exists at all stages of distribution, average prices for a quarter or half year may not differ materially from those to be expected under pure competition; beef appears to provide a fairly good example.

Concluding Comments

Attention to market power in the food and other industries is only recognition that a degree of oligopoly characterizes most of the American economy. When a market is not purely competitive, firms have joint price, output, and, often, promotion decisions to make in selling (or analogous joint decisions in purchasing supplies or hiring labor). Firms then have options that purely competitive firms do not and commonly will be aware that the decisions made by at least some individual firms will have a direct and immediate impact on all. Such firms have power, and power and rivals' reactions to it will be taken into account in choosing among options.

The resulting behavior, especially in the short run, is different from that in a purely competitive market. Some firm must, of course, initiate a price change when one occurs under pure competition,[12] but which firm makes the first move is likely to be a random matter and to have no effect on subsequent events. Innovations are made under pure competition, but the adoption of a superior method or product by a single firm has no direct effect on any other, and only imitation by many competitors in search of profits gradually affects prices and brings about industry-wide change. Obvious differences in price and output stability, manner of price change, introduction of innovations, and other aspects of behavior result under the two market structures. The psychology of markets is also different; under oligopoly, rivalry is personal, firms have character, power is part of the industry environment; under pure competition, everything focuses impersonally on price, and producers may not even regard each other as rivals.

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[11] In 1965-66, sixty food chains had after-tax average earnings on net worth of 11.48 percent [1, p. 10]; average earnings of manufacturers of foods and kindred products in 1966 were 11.2 percent [2, p. 293].

[12] When both buying and selling are purely competitive. Changes in prices for farm products often are initiated by buyers who are not purely competitive.

The presence or absence of market power is not an indication of the quality of industry performance, a topic too complex to develop here. Schumpeter, Galbraith, and others are surely more right than wrong when they argue that market power has positive virtues in a dynamic, technologically advanced economy. Moreover, pure competition is not a feasible alternative for most industries, including foods—the costs of sufficiently small production units are too great. The art of getting good performance involves accepting many necessary and often useful forms of power while preventing those that threaten the effectiveness of the competitive—though not purely competitive—system.

Of the numerous sources of market power, a significant market share usually is necessary, and a large market share is sufficient in the short run. A firm with a large share of the market cannot avoid substantial influence on rivals, customers, and suppliers, and on prices or associated market variables, if it makes a significant move in any direction. High product differentiation gives a firm 100 percent of a market that is in some degree insulated from others. Several others sources of market power have in common the capacity to enable the firm to survive while it pursues aggressive tactics of its own or defends itself against its rivals. Large financial resources and diversity over many product lines or geographically limited markets serve this purpose, and vertical integration, superior operating efficiency, and great marketing ability contribute something to it. Market power is not equivalent to the ability to make high profits, though that may be one of its effects, and conventions as to who quotes prices are not reliable indicators of market power.

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An Analysis of Cooperative Bargaining in the Processing Tomato Industry*

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This article analyzes factors which affected the bargaining process and outcome of negotiations for the processing tomato industry in Indiana and Ohio during the 1966 growing season. Data obtained from Indiana and Ohio tomato processors, grower representatives, and growers was used to reconstruct the bargaining process to determine what factors were considered in establishing contract objectives, to determine various factors each party thought affected bargaining strength and the outcome of negotiations, and to measure attitudes about bargaining.

Substantial differences were found between the parties' conception of supply and demand response and those estimated statistically. Processors and grower representatives underestimated supply response and consumers' response to higher prices. Significant differences between grower and processor attitudes toward bargaining were identified. Processors were primarily concerned about quality factors and growers with price. This suggests that a "trading off" of concessions would benefit both parties.

THE purpose of this article is to analyze factors which affect the bargaining process and the outcome of negotiations in a specific industry at one point in time: the processing tomato industry in Indiana and Ohio during the 1966 growing season.

Theoretical Framework

Previous studies

Previous studies of bargaining can be classified as those using controlled experiments and those that analyzed specific bargaining situations.[1] Most of the controlled experiments have examined the pattern of bargaining behavior in a simplified situation where one factor affecting outcome was varied in a series of experiments [see, for example, 1, 8, and 9]. Factors that were varied include level of information among rivals, number of rivals, number of bids and offers, level and differences in incentives or pay-offs, psychological traits of bargainers, communication among rivals, and the like. This approach offers the opportunity to observe how the behavior of bargainers corresponds to that hypothesized under controlled conditions. A shortcoming is that the experiment must necessarily be rather simple compared with reality and there may be considerable

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interaction among the variables which are treated independently in separate experiments. In addition, the subjects for the experiments have usually been college undergraduates and generalizations based on the behavior of sophomores is risky.

Studies of actual bargaining situations in agriculture have been limited to milk and specialty crops [3, 4, 5, 6] and those outside of agriculture mainly to labor negotiations.

Schneider analyzed the possibilities of bargaining success under different demand and supply elasticities and focused on determining the economic negotiotion limits [6]. Siegel and Fouraker [1, 8], through controlled experiments, analyzed the role of information and other factors as they determined the price negotiated within the limits prescribed by economic forces. This study attempts to build on these earlier works by analyzing economic and non-economic factors that influence the bargaining process and outcome in an actual situation These same factors are hypothesized to be strategic in terms of reaching an agreement. The general hypotheses to be tested were:

1. Historical and organizational factors influence bargaining power and the bargaining process.
2. Growers and their bargaining representatives do not have common contract objectives and homogeneous attitudes with respect to bargaining.
3. Processors do not have uniform contract objectives and attitudes toward bargaining.
4. Buyer and seller objectives and considerations in establishing objectives are different, creating conflicts to be resolved.
5. Grower objectives and attitudes are different according to farm characteristics and organizational affiliation, i.e., not homogeneous.
6. Grower, grower representative, and processor conceptions of economic factors related to supply and demand for tomatoes are not consistent with empirically verified relationships.
7. The nature of supply and demand relationships is such as to create conflicts to be resolved in the bargaining process.

Data

Data was collected from Indiana and Ohio processors and grower representatives in June and July of 1966, after the contracts for the season

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fecting Cooperative Bargaining in the Processing Tomato Industry," unpublished M.S. thesis, Purdue University, 1968. Helpful comments and suggestions by Paul Farris, Don Paarlberg, and George Ladd are gratefully acknowledged.

[1] In addition, there have been numerous descriptions of bargaining situations for particular commodities, mostly reported in *Proceedings—National Conference of Fruit and Vegetable Bargaining Cooperatives*, FCS, USDA, Washington, D.C., 1957–1968.

had been established. During a personal interview with processors, a questionnaire was administered to generate the basic data for the study. A tape recorder was used to register the reconstruction of bargaining activity. Five complete questionnaires and one partially complete questionnaire were obtained from a population of ten tomato processors who had negotiated a contract for raw tomatoes with the bargaining committee of the grower organization. This contract was written for all members delivering to the processor and usually for any nonmembers. Twenty processors from a population of twenty-six who had not negotiated a contract with the bargaining committee in 1966 but had dealt with growers individually completed a questionnaire. Similar questionnaires and methods were used to obtain data from seven grower bargaining committees with a total representation of 25 members, and a group interviewing technique was used to reconstruct bargaining activity. Three officials of the Indiana Agricultural Marketing Association (I.A.M.A.) and the Ohio Agricultural Marketing Association (O.A.M.A.), affiliates of the American Agricultural Marketing Association, provided data.

A mail questionnaire was sent to all members of the two associations in October 1966. A total of 473 usable questionnaires was returned (66 percent), considered satisfactory in view of the fact that some association members were pickle or sugar-beet growers.

The above data consisted of respondents' estimations of supply and demand factors, factors considered in establishing contract objectives, factors affecting bargaining strength and outcome, and scales to measure attitude toward bargaining and bargaining associations. Secondary data were used to estimate statistically supply and demand relationships.

From a methodological standpoint, two interesting problems arose. The first was the processors' reluctance to discuss their pricing and bargaining philosophy. Only under the assurance of strict confidence would they discuss such sensitive matters at all, and even then they considered certain information to be classified. The second problem was their wariness of the tape recorder. Virtually all would have preferred not to use it, and some would not allow its use. Undoubtedly future studies of bargaining will encounter similar sensitivity problems. Careful planning and advance contact should be made to allay respondents' apprehensions.

Analysis of Bargaining

The process

In both Indiana and Ohio, negotiations are conducted annually with individual processors. However, one of the national packers is selected for initial bargaining in an attempt to set the pattern for the rest of the individual processor negotiations. A local bargaining committee of the marketing association is responsible for negotiating with each processor; it is elected from the total local association membership selling to that processor. All negotiations within a state are conducted under the guidance of the state association.

The first step for both processor and grower representatives is to formulate their objectives for the contract; after that, they are ready to bargain. Typically, the bargaining committee makes the initial contact with the processor; then the negotiation follows a pattern consisting of three stages.

Stage one—the processor recognizes the association as the bargaining agent for its member-growers. (The processor is currently under no legal obligation to recognize the association and may at any time refuse to deal with it.)

Stage two—each side announces its contract objectives for the forthcoming growing season, thus signalling the beginning of direct bargaining.

Stage three—attempts are made to resolve differences and negotiate a contract. This stage continues until agreement on a contract or until either side withdraws from the negotiation. During this period either side may attempt to influence the other's position through the use of various strategies.

This bargaining process is illustrated in Figure 1, which suggests that bargaining parties' contract objectives are related to their perception of economic, historical, organizational, and demographic factors which they translate into relative bargaining power. Strategies are dictated by the level of goals and determine an outcome; this may be a stalemate, in which case the process may continue or terminate. Although some perceptions may be incorrect (an apparent case in point is discussed later), they do help to explain the behavior of parties to the negotiation. Identification of misconceptions may be used to reconcile expectations with outcomes; and, as a result, the bargaining process may work more smoothly.

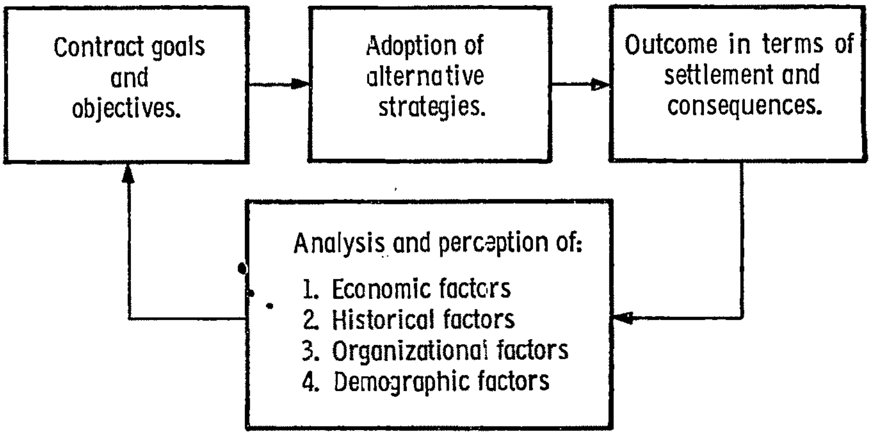
Contract goals and objectives.
Adoption of alternative strategies.
Outcome in terms of settlement and consequences.
Analysis and perception of:
1. Economic factors
2. Historical factors
3. Organizational factors
4. Demographic factors

Figure 1. Model of bargaining process in tomato industry

Contract objectives

In the aggregate, there was significant agreement as to contract terms desired (Table 1) within each of the groups (growers, grower representatives, and processors), as indicated by Kendall's coefficient of concordance. There were differences, for example, between growers in the two states, between growers with different organizational affiliation, and the like, which will be discussed later. It is apparent that growers were interested primarily in price and processors interested in quality, which suggests areas for a "trading off" of concessions.

Table 1. Comparison of growers, grower representatives, and processors in their rankings of contract terms desired

Contract term desired	Pooled rankings[a]	
	Growers	Committeemen
1. Improved grading	2	3
2. Increased acreage	6	6
3. Higher prices	1	1
4. Elimination of hamper restriction	5	4
5. Assistance in production or harvesting	4	5
6. Improved terms of delivery	3	2

Contract term desired	Processor
1. Year-to-year stability in production	3
2. Year-to-year stability in growers	4
3. Low price for raw tomatoes	5
4. High levels of production	2
5. Production of the quality of tomato you desire	1

[a] Value of Kendall's coefficient of concordance for growers' rankings was .464, for committeemen's rankings it was .423, and for processors' rankings it was .888. All coefficients were significant at the five percent probability level.

To determine the importance of various factors influencing the contract objectives of each party, the interviewees were presented with a list of factors hypothesized to affect their objectives. They were asked to indicate whether they had considered each factor, and of those considered, to rank the five most important.

On the basis of the background data from the questionnaire and the taped portion of the interview, an analysis was made of the variation in the processors' attachment of importance to specific factors. The importance of these factors was determined by weighting the percent of processors who considered the factor and the rank weight the factor received. The factors are here arranged in order of decreasing importance.

1. Other raw tomato contracts offered—All processors considered this had an effect on their objectives. The smaller regional canners tended to rank this item among the five most important; the national canners did not.

2. Method of grading raw tomatoes—Differences in processor response were related primarily to whether they used a Federal grading system. The one canner who used his own grading system felt this was an important factor in establishing his contract terms.

3. Alternative sources of supply—The larger national canners felt it would be easier to obtain new growers or develop new areas of production than did the smaller canners. The greater importance attached to this factor by large canners appeared to be related to feasibility.

4. Size of the finished product carryover—Differences in response again appeared related to firm size. The national canners attached more importance to this than did the smaller canners, primarily because they use carryover information as a variable in their pricing decision while the smaller canners tend to follow the price established by the nationals in both finished and raw product markets.

5. Growers' average costs—This factor was more important to the national canners than to the smaller canners. The main organizational and bargaining thrust by the associations has been directed toward the larger canners who are thus made aware of growers' costs as part of the association rationale for their contract demands.

Non-bargaining processors were asked to rank a similar set of specific factors, and the importance of these factors was evaluated in the same fashion. The results were the same as for the bargaining processors, except that this group also considered growers' loyalty to the processor.

Grower representatives also evaluated a set of factors hypothesized to affect their objectives and ranked the following as most important: their strength in a processor's procurement area, other raw tomato contracts being established, growers' average costs, method of grading, processors' alternatives to utilizing growers' tomatoes, growers' alternatives to dealing with the processor, and the processor's tendency to over-contract.

Strategies

During the course of negotiation, either party may attempt to influence the other party's objectives or to alter his conception of his own position, through various strategies. Processors' strategies included: (1) attempting to contract with non-member growers before the contract had been settled with the association, (2) pointing out fallacies in the bargaining committee's rationale for its terms, (3) using other contracts being established to strengthen the rationale for their position or weaken the rationale of the bargaining committee's position, and (4) reminding member growers of the services supplied to them by the processor.

Strategies used by bargaining committees included: (1) attempting to use other contracts being established to strengthen the rationale for their position or to weaken the rationale of the processor position, (2) conditionally approving a contract (i.e., accepting the processor's contract with the condition that he agree to pay the "going price" in the area), (3) attempting to condition the bargaining environment by articles in newspapers and the like, and (4) offering services to the processors.

Outcome

No attempt was made to predict or evaluate the prices, acreages, or other terms of trade negotiated. Higher prices and terms of trade more favorable to growers were negotiated in 1966, although agreement between grower representatives and processors was not reached in all cases. Agreements with major processors were not reached until very late in the season (May), which created difficulty for both growers and processors.

Factors Affecting Objectives and Outcome

Economic

Economic forces place restrictions on the terms of trade that can be negotiated. Higher prices can be negotiated more readily if consumers are not responsive to price increases. Likewise, bargaining for higher prices is more feasible when farmers do not greatly increase production in response to higher prices.

Grower representatives and processors were asked to estimate the degree to which acreage would be added in response to higher raw tomato prices. In general, they felt this response would be quite small.

The supply response for planted acres of tomatoes in Indiana and Ohio was estimated by least-squares single equation regression, using the following data: 1946–65 acreage planted; average seasonal tomato price received by farmers deflated by index of prices paid; six-year moving average of tomato prices deflated; weighted index of alternative crop prices deflated; and a production cost index.[2] Short- and long-run price elasticities of supply of planted acreage for Indiana were 2.18 and 4.49, respectively; and for Ohio, 1.05 and 2.65 (significant at 5 percent level). These supply elasticities imply difficulty in maintaining price and income gains from bargaining, in the absence of supply management. The difference in responsiveness as estimated by grower-representatives compared with the statistical analysis may result in misjudging the need for supply control.

Asked to estimate consumer response to higher tomato product prices, processors felt that consumers were responsive to price differences between brands (low-brand loyalty) but were fairly unresponsive to changes in the level of price. A statistical analysis of demand relationships resulted in a price elasticity of −.76, but the coefficient was not significant. Much of the difficulty in estimating demand relationships was attributed to data problems. Shuffett estimated the price elasticity of demand for tomato products at the retail level to be −.40 [7]. He also pointed out data limitations. If the demand elasticity lies within the range of the above coefficients, processors are probably underestimating consumer responsiveness and grower representatives are not according this factor enough weight in setting contract objectives.

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[2] Attempts to use two-stage least-squares estimation procedures were handicapped by specification of state supply areas and national market for product, as well as converting acreage and volume data. The procedure used does reflect the situation in which price is fixed prior to each year's planting and acreage contracted adjusts to this price.

Historical

Contract negotiations may be influenced by the results of previous negotiations. Disappointments or adverse consequences in previous years can affect current demands and bargaining power. Continued failure reduces the effectiveness of the organization as the organization is perceived by its members in a historical setting.

One difference in the effectiveness between marketing associations was felt to be historical. Ohio tomato growers had themselves formed an association on the basis of a felt need and later became affiliated with O.A.M.A. Some of the problems that face a new organization had already been overcome by then. In Indiana, on the other hand, the association had to convince farmers of their need for its program. At the time of the study, this group was at a different stage of development and was still going through the "growing pains" of increasing and consolidating membership and obtaining processor recognition. Its activities were thus somewhat different from those of O.A.M.A.

Organizational

There are many ways a group can organize, and this can affect its ability to bargain. The organizational form must facilitate communication from members to organizational leaders and vice versa; it must make the member feel an identification with the organization and a responsibility to it; and it must permit rapid decision making. Growers pointed to several problems in bargaining that are organizational in nature.[3]

Demographic

Farms are changing rapidly; they are becoming larger and more specialized. Some have felt this would improve farmer bargaining power, believing that more common interests might facilitate agreement about bargaining goals and methods. There was some evidence in this and another study [2, pp. 17–35] that the reverse might be the case; that is, that the larger farmer feels more independent and does not recognize the need for organization.

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[3] On the 473 questionnaires, 324 growers responded to an invitation to make comments. Their remarks concerning problems in bargaining were classified as follows: lack of unity (27 percent), low membership (22 percent), organizational and leadership difficulties (12 percent), lack of processor recognition or unfair tactics (28 percent), and method of bargaining, mostly lateness of contract (11 percent).

Growers with larger operations had slightly less favorable attitudes toward bargaining and their associations. However, size of farm and degree of specialization were not significantly related to desired terms of trade or opinion of factors influencing bargaining power. Membership in organizations other than the marketing associations also was associated with attitudes toward bargaining. Grange members, NFO members, and members of milk cooperatives held more favorable attitudes toward bargaining than did growers not belonging to these organizations.

Attitudes toward bargaining

The bargaining parties' perception of the four factors discussed above in part shape their attitudes toward bargaining. Attitudes are also formed on the basis of expectations and realized results in previous periods. Relationships and behavior of parties during the actual process shape their attitudes about each other. Attitudes may give some indication of satisfaction with bargaining. More favorable attitudes toward bargaining and the rival may improve the chances for successful negotiation.

The attitudes of the three groups were obtained by means of a scaling device composed of a set of statements referring to the concept of bargaining or the association. Within each of these classifications, the statements were further subdivided as referring to economic or ethical aspects of the concepts. The economic aspect statements reflected considerations which might have an economic impact on the respondent. The ethical statements reflected the respondent's philosophical reaction to either the concept of bargaining or the association.

In comparing mean scores of attitudes among growers, grower representatives, and processors, the latter group was found to be significantly less favorable in their attitude toward bargaining and the bargaining association (Table 2). The higher scores compiled by committeemen as compared with growers, suggest they may be more dedicated members. Their scores may have been affected by their service on the committee, or they may have been elected because of more favorable attitudes. All groups compiled slightly more favorable scores on the concept of bargaining than on their association attitudes. In the case of growers and their representatives, this suggests a gap between expectations and performance. The scores on ethical aspects of bargaining and the association were more favorable than scores on economic aspects. This suggests that the different groups are not opposed to bargaining or the associations on philosophical

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Table 2. Comparison of growers, grower representatives, and processors in their attitudes toward bargaining and the bargaining association

	Attitude scores[a]		
	Growers	Committeemen	Processors
Bargaining attitude			
Economic aspects	4.08	4.30	2.90
Ethical aspects	4.09	4.29	3.03
Association attitude			
Economic aspects	3.34	3.58	2.61
Ethical aspects	3.75	4.13	2.76

[a] Values less than 3 reflect an unfavorable attitude and values greater than 3 a favorable attitude, based on four classifications of 20 attitude statements which could take on values from 1 to 5.

grounds. Rather, processors are more concerned about the economic impact of bargaining, and growers seem more skeptical about economic gains than about ethical aspects of the technique.

A comparison was made between attitudes of processors who had refused and those who had not refused recognition of the association. Attitude scores of the processor, of growers delivering to the processor, and of the grower committee negotiating with the processor were all much higher when a contract had been negotiated. This supports an attitude formation theory that favorable bargaining experiences result in more favorable attitudes, which in turn make the process work more smoothly.

Bargaining strength

Bargaining processors, grower representatives, and growers were asked to rank factors contributing to their respective bargaining power. Significant agreement was found in each group.

Processors and grower representatives felt that control over the supply of tomatoes was the most important factor, while growers attached much importance to the skill of negotiators (Table 3). Processors attached more importance to their ability to pass raw product price increases to the next level forward than did growers or their representatives. All groups attached relatively low weights to the ability of one party to offer advantages to the other for accepting its proposal.

Bargaining environment

Bargaining processors and grower representatives were asked to rank factors affecting the ability of parties to reach agreement (Table 4). Both parties attached most importance to the information possessed by the respective parties. The processors felt that the willingness of parties in ne-

Table 3. Comparison of growers, grower representatives, and processor in their ranking of factors contributing to bargaining power

Factor	Pooled ranking[a]	
	Growers	Committeemen
1. Control over the supply of tomatoes by the association	4	2
2. Unity and loyalty of growers	1	1
3. Ability to offer advantages to the processor for accepting proposal	3	3
4. Ability of processor to pass price increase on to the next level	5	5
5. Skilled and informed association negotiators	2	4

Factor	Processor
1. Flexibility of processing alternatives both locally and in other plants	2
2. Alternative sources of supply (non-member or other production areas)	1
3. Ability to offer advantages to the cooperative for accepting proposal	4.5
4. Skilled and informed processor negotiators	4.5
5. Cohesiveness of processors in area	6
6. Ability to pass price increase to next level	3

[a] Value of Kendall's coefficient of concordance for growers' rankings was .167, for committeemen it was .343, and for processors it was .415. All coefficients were significant at the five percent probability level.

Table 4. Comparison of grower representatives, and processors in their evaluation of factors affecting the ability of parties to reach agreement

Factor	Pooled ranking[a]	
	Committeemen	Processor
1. Compatibility of people doing the negotiating	3	4
2. Willingness of opponents in negotiation to offer something in return for their demands	4	2
3. Level of information each side has concerning why opposite side has taken its position	1.5	3
4. Information each side has about economic considerations of tomatoes	1.5	1
5. Results of previous negotiations	5	5

[a] Value of Kendall's coefficient of concordance for committeemen was .141 and for processors it was .312. Both coefficients were significant at the five percent probability level.

gotiation to offer something in return for their demands was more important than did the grower representatives. Both sides attached relatively little importance to the compatibility of the negotiators or the results of previous negotiations.

Discussion of Results

1. The hypotheses previously stated were accepted, with the following exceptions: (1) growers and their representatives in O.A.M.A. did have common objectives, while those in I.A.M.A. did not; and (2) grower objectives and attitudes do not vary significantly according to certain farm characteristics.
2. Compared with O.A.M.A., I.A.M.A. was probably in less desirable circumstances with respect to influencing the terms of contract, for the following reasons: (1) lack of a large, well-disciplined membership who controlled a large percentage of the tomato acreage available; (2) a less favorable supply elasticity for tomato acreage; (3) more processors who did not want to become involved with bargaining or did not believe the association had anything to offer if they did negotiate; and (4) a poorer history of performance, in part due to its stage of development, which produced less favorable member attitudes toward bargaining. In addition, legislative and legal activity by O.A.M.A. had resulted in a better bargaining environment for the association in Ohio.
3. Indiana committeemen ranked improved grading first and higher prices third, whereas the growers they represented ranked higher prices first and improved grading second. Lack of common objectives may have adversely affected I.A.M.A. bargaining efforts.
4. Growers place too little emphasis on supply management, in view of their response to higher prices. They overrate the power of skilled negotiators. This may be a case of hope versus experience. Growers hope that control of supply is unimportant and that skilled negotiators are important, because this is the route to easy solutions. Committeemen know better. The associations will have to increase their educational and other efforts concerning control of supply if they are to increase their bargaining power. They may need to establish alternative outlets or processing facilities in order to better manage or utilize the supply of tomatoes.
5. Further work is needed to estimate supply and demand relations, since this information is needed by all parties. Incorrect information about economic factors can make negotiations more difficult and result in undesired and unexpected consequences from the terms agreed upon.
6. Information played a key role in the bargaining process. Processors seem better informed about market conditions and acreage; and there have been differences of opinion about some of the information used, such as cost of production. The bargaining process would operate more smoothly if both parties had the same information; this would eliminate conflicts about accuracy and make objectives more realistic. It suggests the development of an information system for joint use, perhaps by an outside agency.

7. A more formalized process for conducting the negotiations could eliminate some of the problems encountered. A time deadline is essential, so that negotiations do not extend into the planting season, as has sometimes happened. Should this deadline be reached before negotiations are concluded, mediation or arbitration might be utilized to resolve any remaining conflicts. A formalized agreement to bargaining each year would eliminate much of the uncertainty surrounding the establishment of a contract and would allow the parties to negotiate over genuine points of difference rather than spend time determining whether there was to be a negotiation.
8. Both parties to the bargaining process should try to accommodate the primary needs of the other and attempt more integrative bargaining. Processors seem to be primarily concerned with quality factors; growers, with price. This suggests that a "trading off" of concessions would benefit both sides.

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Cash-Futures Price Relationships for Live Beef Cattle*

R. L. EHRICH

The objectives of this study, all pertaining to pricing efficiency, were: (1) to develop a theory of cash-futures price relationships for beef cattle; (2) to measure the factors that have affected cash-futures price relationships during the three years of trade in live-beef-cattle futures; and (3) to provide a framework for evaluating the efficiency of futures markets and hedging in the pricing of feeder cattle. Three types of evidence are employed to attain these objectives. First, the principles of cash-futures price behavior derived from observation of long-established futures markets serve as points of departure, while consideration is given to certain fundamental differences that arise from contrasting commodity characteristics. Second, empirical results relating to supply and demand for feeder cattle are employed to define expected relationships between futures prices and prices of feeder cattle of various weights. Third, data generated by the beef cattle futures market itself are analyzed, although it is recognized that these data cover only a short time period and are therefore of limited usefulness.

Principles of Intertemporal Price Relationships

CASH-FUTURES price spreads are now recognized as a function of stocks in the case of seasonally-produced commodities that need to be stored and are storable in significant quantities. This price—the price of storage—is competitively determined by the supply and demand for storage in the same way as any other price. Moreover, like any other competitively determined market price, it tends to equal the marginal costs of production in the short run—production in this case referring to provision of the storage service.

These conclusions were developed by Working out of empirical studies of wheat prices and stocks [26 and 27], then elaborated in more recent theoretical articles [25, 29, 30]. Brennan expanded somewhat on the details of the makeup of marginal costs of storage and their relationship to observed price spreads [1]. Weymar has recently proposed extending the theory to include "expected inventory behavior over the intervening interval" between spot and futures dates [24, p. 1228].

Working's empirical studies of wheat [25, 26 and 27], Telser's study of wheat and cotton [18], Brennan's results for wheat and oats [1], and my results for spring wheat [6, pp. 65–74], all serve to substantiate the theory that cash-futures price spreads are a function of current inventories for annually produced, storable commodities, under conditions existing in the United States.

Hedging by owners of storage space, in reaction to the market-deter-

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mined price of storage, is the mechanism by which stocks are allocated into or out of storage over time. Such hedging is competitive arbitrage that tends to force cash and futures prices into a relationship consistent with the supply and demand for storage [25, p. 555].

Paul and Wesson have expanded the concept to include prices for services other than storage; namely, conversion of soybeans into products [13, 14] and cattle feeding [15]. In the case of soybeans, spreads between cash prices of soybeans and futures prices of oil and meal are viewed as competitively determined prices of the processing service. Similarly, the value of finished cattle, as determined by the price of a relevant futures contract, less the value of the feeder cattle and feed required to produce a finished animal on the delivery date, is the market value of feedlot services [15, p. 39]. This margin is competitively determined by the supply and demand for feedlot services and is "fairly independent of the commodity prices from which it is derived" [15, p. 39].

Paul and Wesson's conclusions are valid as far as they go, but the analysis was incomplete in a number of respects. First, it did not explain the behavior of price spreads, but merely described the expected spread between values. Second, lumping feed and feeder cattle together concealed an important relationship that theoretically should exist between feed prices, feeder-cattle prices, and expected fed-cattle prices. Third, while the spread between values is independent of the commodity prices from which it is derived, the spread between prices of feeder cattle and future prices of finished cattle is directly dependent on the level of futures prices. The latter conclusion will be shown to be a direct result of the nature of demand for feeder cattle.

The Demand for Feeder Cattle

Applying the reasoning of neo-classical firm theory to cattle feeding, it is clear that the quantity of cattle placed on feed should be a function of expected fed-cattle prices, feed prices, feeder-cattle prices, and prices of other factors of production. J. D. Goodwin quantified such a relationship in a recent study, using quarterly placements of feeder cattle on feed in thirteen states as the dependent variable [8]. His results were consistent with theory in that placements were an increasing function of fed-cattle prices and a decreasing function of corn prices and feeder-cattle prices [8, p. 24]. Feed is the single most important factor of production other than feeder cattle, so the price of corn served as a proxy variable for all factors of production other than feeder cattle.

Other evidence throws doubt on the validity of Goodwin's results. First, the statistical results do not hold when data for 1963–1966 are added to the analysis.[1] Second, annual marketings of fed cattle did not vary cyclically as did total commercial slaughter of all cattle (Figure 1).

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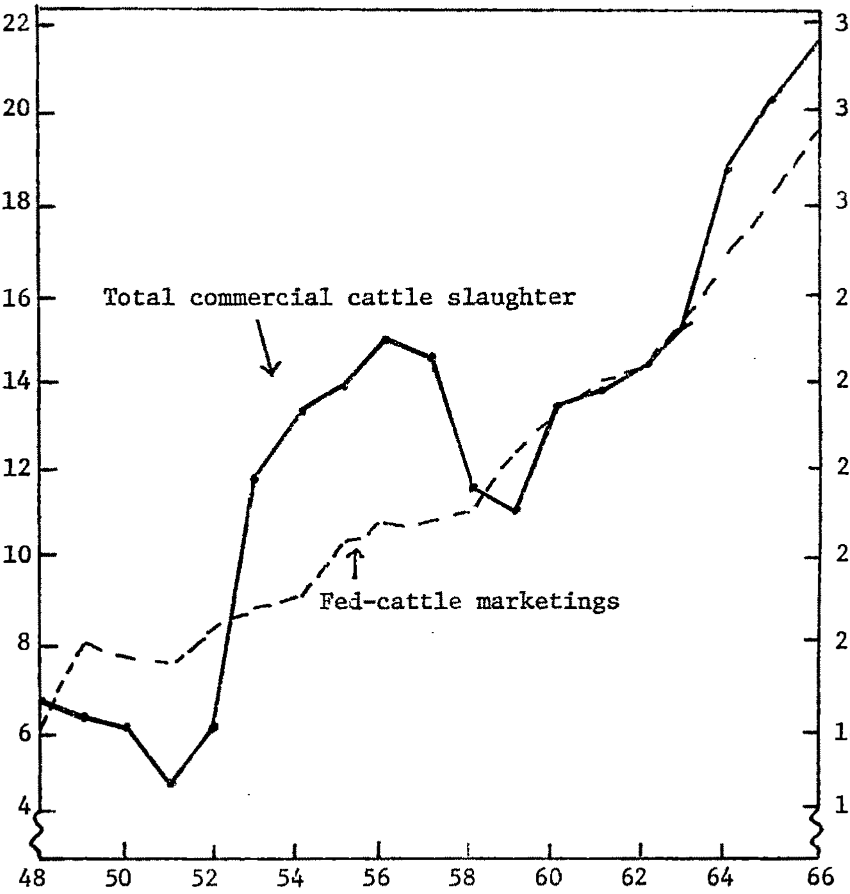
[1] Goodwin used logarithms of quarterly data for 1955–1962. His regression co-

Figure 1. **Marketings of cattle from feedlots in 26 states[a] and total commercial slaughter of cattle in the United States, 1948–1966[b]**

(Million head)



Sources of basic data: Fed-cattle marketings from [2 p. 37], for 1948–1960, and [19] plus recent supplements, for 1961–1966. Commercial cattle slaughter from [19] and recent supplements.

[a] Twenty-six states from 1961 through 1966. Number of states not given for 1948–1960 period.

[b] Scale for fed-cattle marketings on left and scale for total commercial slaughter of all cattle on right.

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efficients were −.45230 for the price of feeder cattle, +.94890 for the price of fed steers, and −.91231 for the price of corn. All were significant at the one percent level of probability and R^2 was equal to .96 [8, p. 24]. Regression coefficients calculated after adding 1963–1966 were +0.09364, +1.06561, and +0.15604 for feeder-cattle prices, fed-cattle prices and corn prices, respectively, and R^2 was equal

Implications of the first evidence for the theory of demand for feeder cattle are obvious, but the second bit of evidence (Figure 1) requires elaboration. Absence of cyclical variation in marketings from feedlots suggests that the quantity of feeder cattle demanded has not responded to price expectations in past years, because since 1948 prices varied in a fairly regular cyclical pattern that was inverse to the variation of total commercial slaughter [7]. Prices of feeder cattle have responded to expected prices of the finished product, while quantity of feeder cattle demanded has apparently been affected primarily by feedlot capacity and its growth over time. The quantity of feeder cattle available depends on past prices and affects the price of feeder cattle indirectly through its effect on expected fed-cattle prices.

The above relationships were empirically tested and the results using annual averages of the variables for 1947–1964 were:[2]

$$(1)\qquad Pf = 0.146 + \underset{(.097)}{1.140Ps} - \underset{(.015)}{0.061If} - \underset{(.278)}{0.457\Delta Fn}, \qquad R^2 = .92;$$

where

Pf = annual average price of feeder steers at Kansas City ($'s/cwt.),
Ps = annual average price of choice slaughter steers at Chicago ($'s/cwt.),
If = index of prices received by farmers for feed grains (1957–59 = 100), and
ΔFn = annual change in January 1 inventory of beef calves, steers, and heifers, minus cattle on feed on January 1 (million).

Numbers in parentheses are standard errors of the regression coefficients. The coefficient for change in feeder-cattle supplies (ΔFn) suggests that pressure of increased supplies on existing feedlot capacity reduced the price of feeder cattle, given expected prices of feed and finished cattle.[3]

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to .73. None of the above coefficients was significant at the *five* percent level of probability, and the signs of the coefficients for corn and feeder-cattle prices were the reverse of that predicted by theory.

[2] See [7, p. 24].

[3] The reverse was true for decreased supplies of feeder cattle. Equation (1) was also fitted with semi-annual data, adding a zero-one shift variable (S) and letting ΔFn be the same for January-June and July-December. The results were:

$$(1a)\qquad Pf = 1.2052 + \underset{(.0820)}{1.0354Ps} - \underset{(.0120)}{0.0398If} - \underset{(.2454)}{0.0410\Delta Fn} - \underset{(.5504)}{2.4290S}, \qquad R^2 = .85.$$

All coefficients were significant at the five-percent level of probability, except ΔFn. Data were not available before 1955 which would enable estimation of ΔFn for the July-December semester. If data had been available, it is expected that the fit would have been improved, and the coefficient of ΔFn probably would approach statistical significance.

In sum, the short-run demand for feeder cattle was manifest in feeder-cattle-price adjustments to expected fed-cattle prices and feed prices, while quantity demanded was largely a function of growth in feedlot capacity over the longer run.

The above demand function implicitly assumes that expected prices are equal to current prices for both the final product and feed; i.e., in the face of uncertainty, cattle feeders view current prices as their best indication of expected prices. The assumption is of course naive; individual producers undoubtedly formulate expectations in a more sophisticated manner, perhaps even employing simple statistical models to project prices.[4] However, producers' response to uncertainty in the aggregate may well result in patterns of price-quantity relationships commensurate with the naive model. Recursive models of the livestock industry have generally employed lagged price in their supply functions with quite acceptable results in the aggregate.[5] Beyond that, use of more sophisticated models of price expectations must await their further development and testing.

Cash and Futures Price Relationships

Assuming that producers view current fed-cattle prices as their best estimate of expected prices and that purely competitive conditions prevail in the beef-cattle feeding industry, the following equation describes industry equilibrium:

$$PsWs - PfWf - C(Ws - Wf) = 0 \tag{2}$$

where

Ps = current price of fed steers
Pf = current price of feeder steers,
C = total costs of feeding per cwt. of gain,
Ws = finished weight of steers, and
Wf = beginning weight of feeder steers.

Costs (C) include a "normal" profit, giving a zero net return in long-run equilibrium.

If equilibrating forces are operative, a change in price of fed cattle (Ps) will cause prices of feeder cattle to change in the same direction, given the beginning weight of feeder cattle and constant costs of gain. Given Ps, Ws and Wf, a change in C will require Pf to change in the opposite direction. Finally, heavier-weight feeder cattle will receive a lower price than lighter-weight feeder cattle, given that Ps, Ws, and C are held constant. Equation (2) thus provides logical support for the results of equation (1).

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[4] Nerlove examined several alternative models of producers' price expectations in [12].

[5] For examples: Harlow used lagged price to estimate a supply function for hogs as part of a cobweb model of the hog cycle [9]; Larson utilized a variant of lagged price to explain supply response in a harmonic motion model of the hog cycle [10]; and Waugh discussed cobweb models as a class, generally concluding that they are useful for predictive purposes [23].

Manipulation of equation (2) provides clearer insight into expected relationships among prices in equilibrium, assuming constant beginning and ending weights (Ws and Wf). Adding $PSWf$ to both sides of equation (2),[6] combining terms, and simplifying, we have:

$$Ps - Pf = (Ps - C)\left(1 - \frac{Ws}{Wf}\right). \tag{3}$$

Assuming that $Ws = 1000$ pounds and $Wf = 600$ pounds, (3) reduces to:

$$Ps - Pf = -\tfrac{2}{3}(Ps - C). \tag{4}$$

Given the assumed weights, the spread between expected fed-cattle prices (Ps) and feeder-cattle prices (Pf) will be negative if $Ps > C$. If $C > Ps$, then $Ps - Pf > 0$. As Ps increases, $Ps - Pf$ becomes a larger negative number, i.e., Pf increases at a greater rate than Ps. As C increases, $Ps - Pf$ becomes a smaller negative number and eventually becomes positive.

Substituting the price of cattle futures (Ps^*) for Ps in equation (3), we have:

$$Ps^* - Pf = (Ps^* - C)\left(1 - \frac{Ws}{Wf}\right), \tag{5}$$

which describes the forces that affect the cash-futures price spread for beef-cattle, given that the quantity of feeder cattle placed on feed is not appreciably affected by expected prices (equation (1)); i.e., given that prices of feeder cattle adjust to expected prices of fed-animals, while feeder-cattle placements depend primarily on feedlot capacity.

Equation (5) may be stated in other terms, to clarify the nature of market forces which theoretically affect the spread between cash and futures prices. Ps^* is the market determined expected price of fed cattle for delivery at a specified future date. If this price is sufficiently high relative to current feeder-cattle prices (Pf) and costs of feeding, the cattle feeder may sell futures as a hedge, thereby fixing his profit position within rather narrow limits. Such action by many producers acts as competitive arbitrage, theoretically forcing the spread between cash and futures prices to reflect costs of feeding, as indicated by equation (5).

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[6] See [17, p. 641] for a demonstration of the use of this manipulative procedure in another context.

Empirical Tests of Cash-Futures Price Relationships for Beef-Cattle

Beef-cattle futures have been traded for a very short time period, so empirical results must be viewed as somewhat tentative. However, it will be demonstrated that, while the evidence is not sufficient to prove the hypotheses that were developed above, it definitely does not provide grounds for rejecting them, nor does the evidence suggest better alternative hypotheses.

Selection of data representative of feeding costs (C in equations (2)–(4), above) presents a difficult problem because feeding programs vary widely among states and regions. Consequently, choice of data is necessarily somewhat arbitrary. Feeding rations, time-on-feed, non-feed costs, etc., are based on Van Arsdall's results [22] for selected feeding programs that may be considered typical for the cornbelt region.[7] Feed prices used to determine the total cost of feed are average prices received by farmers in Iowa and Nebraska. It is recognized that costs based on cornbelt conditions are probably not representative of costs for commercial feedlot operations in the western and plains states. However, data for the latter type of operation are not readily available in sufficient detail; and at any rate, for purposes of this analysis, the discrepancy should not bias the results.

The feeder-cattle price variable is measured as the weekly average price of choice 550–750 pound steers at Omaha. The futures-price variable is the weekly average price of Chicago cattle futures, calling for delivery six months after the date applicable to the feeder-cattle price, and discounted $.75 per hundredweight to obtain an Omaha basis. Averages were calculated for the week closest to the 15th of the month.

Spreads between feeder-cattle prices and the relevant futures prices are plotted in Figure 2 against per-head costs of feeding for each month from January 1965 through November 1967. Three facts are notable. First, cash-futures spreads and feed costs were apparently unrelated during January 1965 through February 1966 (open circles). This could reasonably have been expected because trade in futures during early months was light. Therefore, prices probably were not truly representative of economic conditions in the cattle feeding industry.[8]

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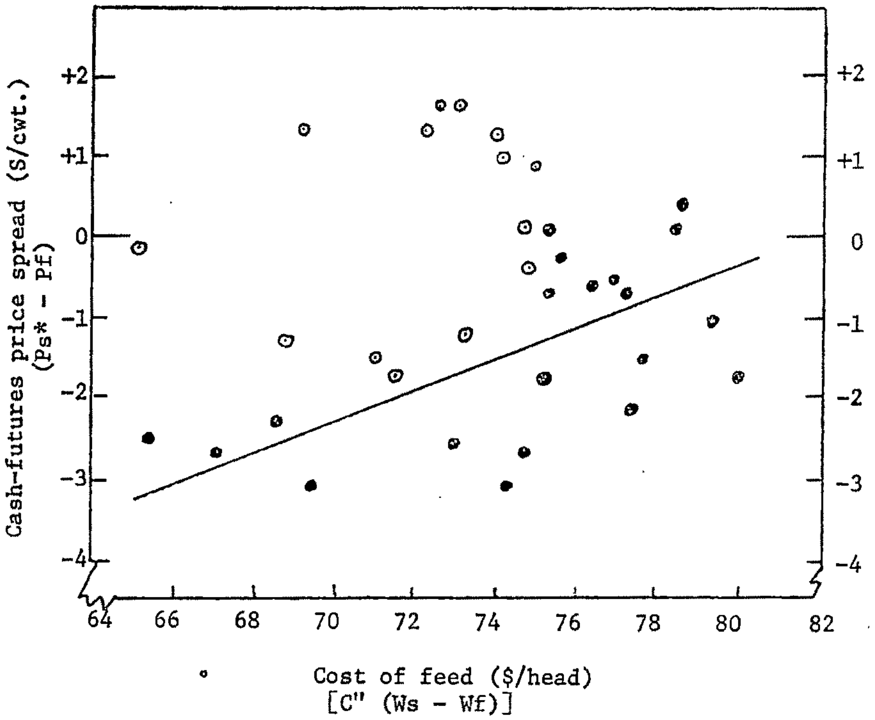
[7] Feed rations and costs used in this study are based on a feeding program wherein 675-pound choice steers are fed for a 180-day period to a market weight of 1080 pounds, in a feedlot with an annual capacity of 240 cattle [22, p. 10].

[8] The average level of month-end open contracts in beef-cattle futures for selected time periods was as follows [3]:

Period		*Av. Level of M.E.O.C.*
1965	Jan.–June	2444
	July–Dec.	4210
1966	Jan.–Dec.	11350
1967	Jan.–Nov.	20205

Figure 2. **Relationship between cash-futures price spreads and feed costs, monthly, 1965–1967**[ab]



Sources of basic data: Cattle prices from [20] and [3]. Feed prices from [21] and rations based on [22, Table B-11].

[a] Spread between weekly average price of choice 550–750 pound feeder steers at Omaha and weekly average price of Chicago live-cattle futures for delivery six months hence. Averages were calculated for the week ending closest to the 15th of each month. The futures price was discounted by $.75/cwt. to put it on an Omaha basis. Feed costs were calculated basis Iowa and Nebraska prices for a ration appropriate for 650-pound steers fed to a weight of 1100 pounds.

[b] Open circles indicate January, 1965, through February, 1966. Closed circles indicate March, 1966, through November, 1967.

The second notable fact is that the cash-futures spread was negative in all months except three during the later time period (March 1966 through November 1967). This is consistent with the prediction of equation (5), above, which says that if futures prices (*Ps**) exceed total per hundredweight costs of feeding (*C*), then the equilibrating mechanism will force the price of feeder cattle above the expected price of fed cattle, given constant beginning and ending weights (*Ws* and *Wf*). Per hundredweight costs of feeding were generally below the expected price of fed animals during the period, judging from Van Arsdall's cost estimates.

Third, the cash-futures spread tended to become less negative as feed costs increased, which again is consistent with the hypothesis contained in equation (5). The fit was not particularly good (Figure 2), making it necessary to qualify the conclusion somewhat. The relatively wide scatter of observations around the hand-fitted regression line was probably caused by two factors. First, monthly data are affected by short-term disturbances associated with the process of price discovery; i.e., prices are generally in disequilibrium because the emergence of pertinent market information tends to occur in a random manner.[9] Second, trade in futures still represents a relatively small proportion of total cattle placed in feedlots in the United States, so forces affecting feeder-cattle prices are probably not fully reflected in futures prices. For example, a large segment of the cattle feeding industry probably persists in viewing current and past "cash" prices as the best available indication of expected prices, thereby disturbing the expected relationship between cash-feeder-cattle prices and futures prices.[10]

Cash-futures spreads are related directly to the spread between futures prices and total per hundredweight costs of gain in Figure 3. Costs are again based on Van Arsdall's data for a 180-day feeding program, adjusted to reflect a beginning weight of 650 pounds and a finished weight of 1100 pounds, and are applicable to a feedlot with a capacity of 240 cattle per year. The upper line of the chart represents the cash-futures price spread necessary to cover all variable costs including feed. For example, if $Ps^* - C = -\$2.00$/cwt., the breakeven cash-futures spread ($Ps^* - Pf$) is $-.69\ (Ps^* - C)$, or +$1.38/cwt. The coefficient $-.69$ is derived from the element $(1 - Ws/Wf)$ of equation (5), above, assuming $Ws = 1100$ and $Wf = 650$.

As predicted by equation (5), the cash-futures spreads tended to become increasingly negative as futures prices increased relative to costs of gain (as $Ps^* - C$ grew larger). The scatter of observations around the "variable cost" line appears random, a fact again consistent with accepted economic theory, which says that short-term market disturbances tend to occur in a random manner.

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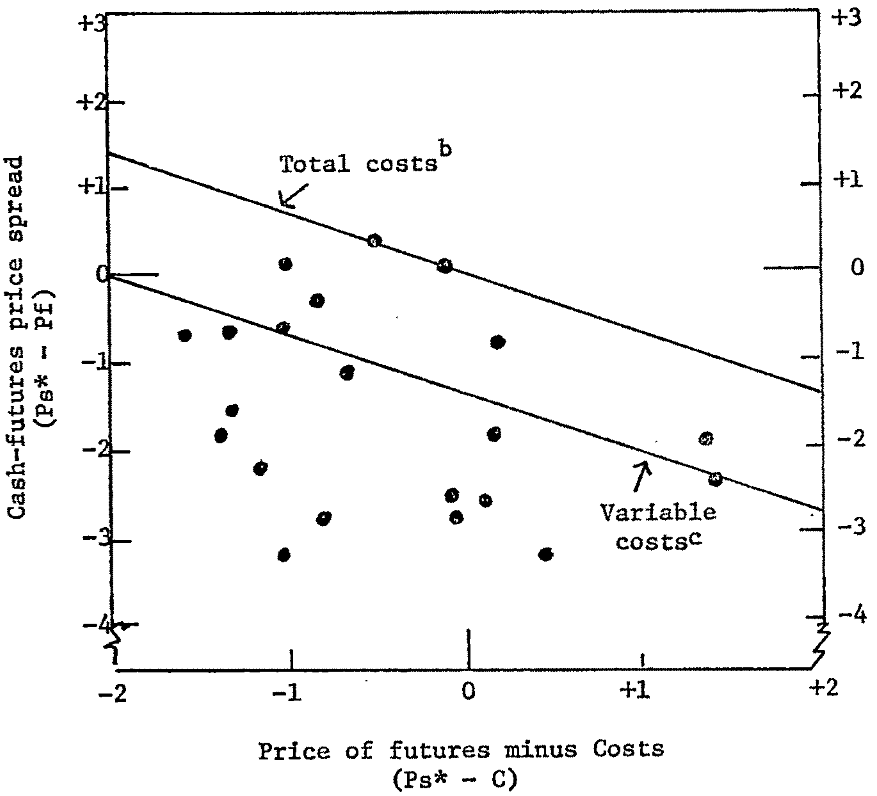
[9] See [11] and [28]. The former is a statistical analysis of daily prices which indicates that short-term price changes behave as a random walk. The latter reference presents a theory of anticipatory prices which, in essence, says that changes in expected prices depend on market news, and new market information tends to occur randomly. Thus, prices continually react to market news, given uncertain future events, producing a short-term price pattern that resembles a random walk.

[10] Still another factor may be seasonal variation in non-feed costs, which costs were not included in the cost variable presented in Figure 2. This factor cannot be tested, because data on seasonal variation in non-feed costs are not available. However, the scatter of observations around the hand-fitted line in Figure 2 had no identifiable seasonal pattern. This suggests that seasonal variation in non-feed costs probably was not a factor contributing to the deviation of individual monthly observations around the regression line.

Figure 3. Relationship between cash-futures price spreads and futures price-cost spreads, monthly, March, 1966, through November, 1967[a]

($'s/cwt.)



Sources of basic data: See footnotes, Figure 2.

[a] Prices are as described in footnote a, Figure 2. C is equal to feed costs plus total non-feed costs. The latter costs were taken from [22, pp. 38 and 58].

[b] Computed as $Ps^* - Pf = -.69(Ps^* - C)$, where C is total costs per hundredweight and other variables are as previously defined.

[c] Computed as $Ps^* - Pf = -.69(Ps^* - C^1)$, where C' includes all variable costs and other variables are as previously defined.

Conclusions regarding the relationship between cost levels and cash-futures price spreads should be made with caution, because the cost data used here may not represent a minimum-cost situation. It is expected that competition will force the price spread toward the break-even point for the lowest-cost firms, if most cattle are fed in low-cost feedlots. Assuming that the break-even level for minimum-cost firms is lower than that represented in Figure 3, the pattern of observations in Figure 3 suggests that cash-futures price spreads tend to vary around equilibrium in a manner consistent with the purely competitive model. That is, the average spread between cash and futures prices over longer periods tends to equal total costs of feeding including a normal competitive profit. Conditions of pure competition are defined here to include the usual assumptions regarding numbers of firms and homogeneity of product. Additional assumptions are that uncertainty exists, market information emerges in a random manner, and a time lag is required for adjustment to disequilibrium.

Another difficulty of interpretation of the relationship between costs and cash-futures spreads is caused by the fact that prices of feeder cattle represent choice animals. It is likely that a significant number of cattle feeders purchase "plainer" types of feeder cattle and still market choice fed-cattle. Thus, a bias of unknown magnitude may exist in the size of the cash-futures spread, relative to costs of feeding. For this reason, and because the available cost data may not represent true industry cost levels, firm conclusions regarding the level of costs that are expected to be reflected in cash-futures spreads must await further research.

These reservations notwithstanding, the scatter of observations about the cost lines in Figure 3 suggests an important conclusion with respect to expected short-term price behavior in beef-cattle futures markets. At any given point in time, market prices will tend to be in disequilibrium, owing to random disturbances such as new market information, and will be changing in response to such information, presumably in the direction of equilibrium.

Although the data are not wholly adequate for an analysis of price behavior, certain patterns of dynamic price adjustment are at least suggested by weekly data derived in the same manner as the monthly data discussed above. These data provide a partial test of the hypothesis that cash-futures price spreads adjust toward a "break-even" relationship, in a direction commensurate with its dislocation from the "break-even" or equilibrium point in a previous time period. Gross returns per hundredweight for feeding cattle, as indicated by the cash-futures price spread minus variable costs of feeding, were compared to weekly changes in cash and futures prices during the following month.[11] The results are summarized in Table 1.

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[11] For example, net returns over variable costs for feeding cattle (R) are calculated as follows, using monthly average values of the variables:

$$Ps^*Ws - PfWf - C'(Ws - Wf) = R,$$

where Ps^*, Pf, Ws and Wf are as defined above, and C' is total variable cost per hundredweight, other than the cost of the feeder cattle. R is then related to the change in feeder-cattle prices and relevant futures prices during the four weeks following the month applicable to R.

Table 1. **Monthly average returns from cattle feeding, as indicated by the cash-futures price spread, compared to the change in cash and futures prices during the following four-week period, January 1966 through November 1967**

($'s/cwt.)

Item	Level of Returns[a]					
	Low	Medium	High	Low minus medium	Low minus high	Medium minus high
Average change in futures price[b]	+.19 (.28)	−.12 (.33)	−.41 (.27)	+.31 (.44)	+.60 (.40)	+.29 (.84)
Average change in feeder-cattle price[b]	−.40 (.16)	+.16 (.07)	+.46 (.30)	−.56 (.18)	−.86 (.32)	−.30 (.27)
Number of months in the average	8	8	6	16	14	14

Sources of basic data: See footnotes, Figure 2.

[a] The range of monthly profit levels (22 total) was as follows:

Low = −$5.46 through +$4.37 per head,
Medium = +$8.40 through +$14.24 per head,
High = +$16.05 through +$32.62 per head.

[b] Numbers in parentheses are standard errors of the means and mean differences, respectively.

When monthly average returns were low, feeder-cattle prices declined by an average of $.40/cwt. during the following four-week period. Futures prices tended to rise following low-returns months, but the average change was not statistically different from zero. Feeder-cattle prices increased by an average of $.16/cwt. and $.46/cwt. during the four weeks following months of medium and high returns, respectively. Again, futures prices tended to decline following high-profit months, but the average change was not significantly different from zero.

The rather limited data presented in Table 1 clearly indicate a tendency for feeder-cattle prices to adjust toward equilibrium ("break-even" level) as predicted by the hypothesis, while adjustment in futures prices was less consistent with the hypothesis. The evidence shows fairly clearly that competitive forces tend to cause feeder-cattle prices to adjust relative to the relevant futures price in a manner consistent with the assumptions of pure competition, given uncertainty regarding future events. Periods of disequilibrium tend to be followed by adjustments toward competitive equilibrium.

Conclusions and Implications for Pricing Efficiency in the Beef-Cattle Market

Demand for feeder cattle is manifest in adjustment of current feeder-cattle prices to expected fed-cattle prices, costs of feed, and changes in available feeder-cattle supplies. Current placements on feed tend not to respond to price relationships, but are governed in the short run by feedlot capacity. Feedlot capacity has trended upward since 1948, reflecting favorable average profits in the cattle-feeding industry since that time.

These structural demand characteristics for feeder cattle provide a framework for construction of a theory of cash-futures price relationships for beef cattle. Under purely competitive market conditions, cash prices of feeder cattle and futures prices will bear a relationship to one another which is determined by costs of feeding and the level of futures prices. In competitive equilibrium the following equation holds:

$$Ps^* - Pf = (Ps^* - C)\left(1 - \frac{Ws}{Wf}\right).$$

Judging from empirical evidence, it is concluded that this equation is the appropriate model of cash-futures price relationships for beef cattle. Observed price spreads varied around predicted equilibrium in a manner consistent with behavior in a purely competitive market, given uncertainty regarding future events. Weekly changes in feeder-cattle prices were consistent with the prediction of the theory. Hedging by cattle feeders is the competitive mechanism by which these price adjustments are made in the market-place.

A major problem remains regarding an appropriate concept of costs (C). Presumably, competition will force price spreads into line with the cost structure of low cost firms. However, a definitive statement regarding the expected relationship between levels of cost and levels of cash-futures spreads must await further research.

Certain conclusions about expected price behavior and pricing efficiency are possible in view of the results of this study. Cash prices of feeder cattle are tied by economic forces to prices of futures contracts. Specifically, the cash-futures price spread is the market price for cattle-feeding services, and as such coordinates decision making in the industry. However, unlike the case of storable commodities, where cash-futures spreads signal adjustments in quantity stored, it is not expected that quantities placed on feed will adjust to cash-futures price spreads for beef cattle. Rather, the price of feeder cattle will adjust to expected fed-cattle prices, the latter being determined by inventories of available feeder cattle and expected demand.

One major implication of the last conclusion is that the existence of futures markets will facilitate more efficient adjustment of feeder-cattle prices to feeding costs and price expectations. In the absence of a market-determined expected price, uncertainty most probably forces discounting of the future, with consequently inefficient adjustment in prices paid for feeder cattle. Futures trading may remove much of this pricing inefficiency.

Several questions requiring additional research are suggested by the analysis. What cost elements in the cattle-feeding industry are important for predicting the behavior of cash-futures price spreads? Will the existence of a futures market precipitate significant adjustments in the structure of the cattle feeding industry? In particular, will cash-futures spreads tend to reflect the cost structure of highly efficient, large-scale commercial feedlots, thereby forcing smaller farmer-feeders out of the industry? Finally, what, if any, are the implications of futures trading regarding prices received by producers of feeder cattle? For example, will producer-prices approach a competitive ideal and if so, will this change the economic structure of the feeder-cattle production industry?

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The Allocation of Research, Teaching, and Extension Personnel in U.S. Colleges of Agriculture*

Willis L. Peterson

The aim of this paper is to inventory the allocation of research, teaching, and extension personnel by departments in United States colleges of agriculture and experiment stations, and to identify and measure factors that appear to influence this allocation. Although growth is the predominate characteristic of departments and disciplines, we observe and can predict decline in several instances. With the use of multiple regression analysis, state nonfarm income emerges as the most important variable explaining total funds available to experiment stations. Rural farm population has virtually no effect on total funds available. In fact, since 1960 it was somewhat of a detriment for an agricultural experiment station to be located in an agricultural state. At the departmental level, the departments engaged in farm oriented research (agronomy, animal husbandry, etc.) appear to be more dependent on farm income for support whereas departments in closer contact with the nonfarm sector (horticulture, agricultural economics, etc.) are more dependent on nonfarm income. Predictions for the early 1970's indicate largest growth for departments located in the high income, urban-industrial states particularly for those more closely tied to nonfarm income.

THE growth in technology and productive efficiency of U.S. agriculture is a well-known fact. Moreover, there seems to be little doubt that the research, teaching, and extension activities of U.S. land grant colleges and experiment stations have contributed greatly to making this productivity growth possible. In fact, we are accumulating evidence which indicates that the social rate of return to investment in these activities is high, relative to the rate of return obtained from typical investment alternatives [2, 3, 7]. This would suggest that there has not been an over-allocation of resources devoted to the production and distribution of knowledge in U.S. agriculture.

As in any other production activity, we are concerned not only with the total amount of resources devoted to research, teaching, and extension, but also with the most efficient mix of resources in each. For example, would the social return to agricultural research be higher if less resources were allocated to crop research and more to livestock research, or vice versa? Before questions of this nature, i.e., what should be, can be answered, it seems that we must know first, what is.

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The main objectives of this paper are (1) to inventory the allocation of research, teaching, and extension personnel by departments in U.S. colleges of agriculture and state agricultural experiment stations and (2) to identify and measure factors that appear to influence this allocation. Major attention will be devoted to the research and teaching.

The Data

The main source of data is the annual USDA publication, "Professional Workers in State Agricultural Experiment Stations and Other Cooperating State Institutions" [11],[1] which gives a simple head count of the number of professional people in each department. The data were collected for each state, but because of space limitations only U.S. totals are presented in Tables 1 and 2. These figures include only faculty of the rank instructor or research associate and higher, excluding supporting staff and graduate students. An attempt was made to separate teaching and research from extension, which accounts for the fractions in the data. For example, an individual involved in teaching, research, and extension was counted as two-thirds teaching and research and one-third extension. Since a majority of the personnel are listed either as teaching and research only or as extension only, the figures probably are not seriously biased by this procedure.

Table 1. Number of teaching and research personnel and percent distribution by years, U.S. colleges of agriculture and experiment stations

	1930		1940		1950		1960		1967	
	Number	%	Number	%	Number	%	Number	%	Number	%
Agricultural Economics	300.0	11	356.8	10	586.3	11	836.4	11	994.8	12
Agricultural Education	155.5	6	180.0	5	183.5	4	196.0	3	180.7	2
Agricultural Engineering	178.2	7	272.8	8	472.1	9	683.3	9	756.7	9
Agronomy	355.5	13	579.8	16	855.5	16	1111.9	15	1157.9	14
Animal Husbandry	275.1	10	360.6	10	494.8	10	707.2	10	773.6	10
Dairy Husbandry and Industry	247.8	9	297.7	8	411.2	8	498.4	7	478.4	6
Entomology	262.5	10	350.0	10	464.9	9	706.9	10	870.0	11
Horticulture	385.1	15	478.3	13	655.0	13	807.9	11	841.9	11
Plant Pathology	183.2	7	276.6	7	383.1	7	629.9	9	745.0	9
Poultry	126.9	5	162.9	5	240.7	5	325.1	5	325.0	4
Rural Sociology	37.2	1	63.6	2	87.3	2	106.5	2	132.7	2
Soils	162.0	6	230.2	6	337.0	6	591.5	8	784.1	10
Total Agriculture[a]	2669.0	100	3609.3	100	5171.4	100	7201.0	100	8040.8	100

[a] Includes 48 states.

Particular caution was taken to maintain consistency of departmental personnel between states and over time. For instance, in the 1930's Agronomy, Soils, and sometimes Plant Pathology personnel were identified as

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[1] Called "Workers in Subjects Pertaining to Agriculture in Land Grant Colleges and Experiment Stations" until 1965–66.

Table 2. Number of extension personnel and percent distribution by years, U.S. colleges of agriculture and experiment stations

	1930		1940		1950		1960		1967	
	Number	%	Number	%	Number	%	Number	%	Number	%
Agricultural Economics	95.0	15	225.2	24	232.7	21	368.6	24	490.2	26
Agricultural Education	6.5	1	2.0	—	1.5	—	6.0	—	10.3	—
Agricultural Engineering	47.8	8	96.2	10	134.9	12	177.7	11	204.3	11
Agronomy	71.5	12	108.2	12	135.5	12	171.1	11	186.6	10
Animal Husbandry	73.9	12	80.4	9	105.2	9	160.8	10	189.4	10
Dairy Husbandry and Industry	79.2	13	91.3	10	132.8	12	134.6	9	146.6	8
Entomology	33.5	5	41.0	5	53.1	5	90.1	6	120.5	6
Horticulture	83.9	14	106.7	12	128.0	11	171.1	11	204.1	11
Plant Pathology	23.8	4	27.4	3	30.9	3	50.1	3	71.5	4
Poultry	77.1	12	78.1	8	92.3	8	102.9	7	105.0	6
Rural Sociology	13.8	2	30.4	3	19.7	2	25.5	2	29.3	2
Soils	16.0	2	39.8	4	59.0	5	98.5	6	112.4	6
Total Agriculture[a]	622.0	100	926.7	100	1125.6	100	1554.0	100	1870.2	100

[a] Includes 48 states.

one department. The same was true of Agricultural Economics and Rural Sociology. As departments grew, there was a tendency for some disciplines to split off and become autonomous units, but this tendency seems now to be reversing itself. In the 1960's there has been a trend towards consolidation, as in the livestock areas where some dairy, animal husbandry, and poultry units are merging into animal science departments. Fortunately, since most individuals in multi-discipline departments are identified by field of specialization, it is possible to make a reasonably consistent inventory of departmental personnel in spite of this separation and merging of disciplines.

These data have value because they provide a cross-section inventory of the teaching, research, and extension work within each land grant college and experiment station, information not published in summary form prior to 1966. The 1967 USDA report, "An Inventory of Agricultural Research," presents scientific man-year and expenditure figures for 91 problem areas for 1966 in state agricultural experiment stations, forestry schools, and research agencies of the USDA [9].

To be sure, both the USDA figures and the personnel data presented in this paper have limitations. For one thing, the latter do not reflect with 100 percent accuracy differences in expenditures between departments because of salary differences and differences in supporting facilities and personnel. Also, because no data are available on numbers of graduate students, the amount of research carried out may not be perfectly reflected by the number of research and teaching personnel. Moreover, it is not possible to determine how personnel time is apportioned between teaching and research.

The research expenditure and man-year figures of the USDA report have other drawbacks. First, it is not certain that all funds earmarked for research are actually used for this purpose. One must suspect that in some departments research subsidizes teaching or in others just the opposite may be true. Second, it is often difficult to distinguish teaching from research, as in the supervision of a graduate student's thesis research. Since teaching and research are so closely related at the graduate level, it seems futile to attempt a separation.

Finally, it would be naive to believe that research expenditures are used 100 percent on the problem areas for which they are reported. Because of political pressure, changes in public sentiment regarding urgent problems, and the like, the earmarking of research money to a given problem area may not coincide with the actual use of these funds by scientists. Fortunately, this problem does not come up with department-wide classification, which is one advantage of the personnel data. Perhaps the main advantages of the personnel data, however, are that they coincide with the administrative units in experiment stations and allow us to study changes in the allocation of research, teaching and extension resources at the state and national level over a long period of time.

Allocation in the Aggregate

As might be expected, the predominant characteristic of the data presented in Tables 1 and 2 is the long-run growth in number of personnel, by disciplines. It is of interest, therefore, to note some exceptions to the rule. In terms of teaching and research personnel, Dairy and Agricultural Education exhibit a noticeable decline during the 1960–67 period while Poultry remains about constant. During the 1930–35 period (not shown in the tables), six of the twelve disciplines—Agricultural Economics, Agricultural Education, Agronomy, Dairy, Poultry, and Soils—declined in numbers of teaching and research personnel.

The rate of growth of extension personnel exceeded that of research and teaching in the 1960–67 period—2.9 percent per year for extension compared with 1.7 percent per year for teaching and research. Also, none of the disciplines experienced a decrease in extension personnel during this time. In the depression years, however, extension did not fare as well as teaching and research. With the exception of Agricultural Economics, Animal Husbandry, and Horticulture, all disciplines reduced their extension personnel, and the last two remained about constant.

The big exception is Agricultural Economics extension, where the number increased from 95 in 1930 to 160 in 1935 a rate of growth unsurpassed anytime since then. Very likely, government programs to alleviate the decline in relative farm income at that time provided the support for this large increase. The hypothesis that total number of Agricultural Economics extension personnel is inversely correlated with relative farm income is supported by the record of more recent periods also. During the 1940–50 decade, Agricultural Economics extension experienced virtually no growth whereas in the 1950's and 1960's the growth rate was substantially higher than the U.S. average for all extension. More will be said about the relationship between income and department size in the next section.

Another predominant characteristic is the relative stability of shares allocated to each discipline over the long-run. Disciplines that were given a large slice of the pie in 1930 were still receiving it in 1967, with a few exceptions. Agricultural Education is perhaps most notable in teaching and research, declining from 6 percent of the total in 1930 to 2 percent in 1967. Dairy and Horticulture also lost, in relative terms. On the other hand, it is difficult to explain the large relative size of Horticulture in the 1930's. Perhaps its recent decline indicates a movement towards an "equilibrium" rather than a relative reduction in its emphasis on teaching and research. Soils exhibits the largest relative increase, moving from 6 percent in 1930 to 10 percent in 1967.

In the area of extension, Agricultural Economics stands out both as the largest in 1930 and as the one that experienced the most growth up to the present, although its growth in relative size took place from 1930 to 1935. Soils and, to a lesser extent, Agricultural Engineering also experienced some relative growth during the 1930–67 period. Poultry and Dairy exhibited the largest relative decline over the 1930–67 period.

Of course, the trends in the aggregate figures cover up many changes in individual departments. Although most disciplines grew in absolute numbers, it is not uncommon in any one year to find that some individual departments decreased in size. With the long institutional background of most departments, decline is no doubt a painful process. Merging a department that is declining with one or more larger departments seems to be a fairly common procedure.[2] This probably makes the adjustment process a little easier for the declining department and reduces administrative overhead at the same time.

Factors Influencing Allocation

We now enter an area where conjectures abound but where rigorous, quantitative analysis is in short supply. With a little reflection, it is possible to think of several explanations for differences in growth and size, both at the experiment station level and at the department level.

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[2] Merger does not affect the way in which personnel are reported in this paper. For example, if a poultry department merges with animal husbandry to form one animal science department, the personnel are still reported with their former departments.

Experiment station level

The amount of money made available to an experiment station each year, of course, is the ultimate determinant of its size. Federal funds are allocated largely on a formula basis [12, p. 232].[3] Twenty percent is allocated equally to each state. Not less than 52 percent is allocated on the basis of the size of each state's rural population and farm population relative to total U.S. rural and farm population And not more than 25 percent is allocated to the states for cooperative research in which two or more experiment stations participate on a common problem.

Nonfederal funds, the other major source, have accounted for about 75 percent of total funds available to experiment stations in recent years.[4] The amount of these funds forthcoming to a given experiment station is largely determined by the state's tax base and its willingness to tax. Thus, we might hypothesize that differences in income of the states would be an important variable explaining differences in nonfederal and total funds available to experiment stations.[5] Of course, if we are interested only in predicting funds available in year T, the best predictor would be funds available in year T-1. In the case of a public institution where the majority of personnel have a lengthy, specialized training period and are not subject to layoffs, short-run changes in size are, at most, marginal.

Department level

At the individual department level, we have evidence of both growth and decline. But here as well there is no shortage of explanations. The degree of leadership exercised by the department head and the predisposition of the experiment station director toward the department would matter at least in the short-run. The competence of a department in urgent and important problem areas is likely to be another factor. The rapid growth of Entomology in the grasshopper-infested Southwest and West in the 1930's is one example of this phenomenon. Nor is the decline of Poultry and Dairy departments totally unexpected in states where the two related industries are declining.

Although a single department takes up only a small fraction of an experiment station's annual budget, it can be argued that the income of the state is still important. A reduction in state appropriation because of high unemployment and revenue loss, for example, is generally not borne by one or even a few departments. Poverty or affluence, as the case may be, is generally shared across the entire experiment station. The relative constancy of discipline shares over time bears evidence to this. This is not to say, however, that all departments exhibit the same relationship to income.

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[3] Federal funds include mainly Hatch Act funds, regular plus regional research. These funds made up 90 percent of federal funds in 1966. Also included are funds appropriated by the McIntire-Stennis Act and special grants by the federal government for research and facilities.

[4] Non-federal funds include mainly state appropriations, which made up about 70 percent of nonfederal funds in 1966. Also included are grants from foundations and industry, about 7 percent of total nonfederal funds in 1966. Revenue from fees and sales made up about 13 percent of nonfederal funds in 1966. Fees and sales are not included in the analysis, however, unless specifically stated.

[5] The formulation of this hypothesis should be credited to T. W. Schultz [8, pp. 60–72].

Regression equations and results

In this section, the farm and nonfarm components of state personal income are used as explanatory variables in regression equations in an attempt to explain differences between states in size of experiment stations and departments. Also, the effect on department size of farm production that is closely related to specific departments is estimated. To allow for adjustment time and year to year fluctuations in the income and related farm production variables, lagged three-year (1958–1960) average values of these dependent variables are used.[6]

In addition, the 1960 value of the dependent variable is introduced in all of the regressions. This variable tells us the extent of change in *relative* size of experiment stations or departments, as the case may be, across the country from 1960 to the year of the dependent variable (1966 for experiment stations and 1967 for departments). For example, if all agricultural economics departments were the same size in 1967 as in 1960, or if all grew by X number of people, this variable would "explain" all of the variation between departments in 1967. Thus, if the lagged dependent variable accounts for a large proportion of the variations explained, it is an indication that state experiment stations or departments, as the case may be, have not changed in size very much relative to each other during the 1960–67 period. And most important, if any change in relative size did take place from 1960 to 1967, we can tell whether these changes are related to differences between states in farm or nonfarm income. In addition, the equations with the lagged dependent variable are used in the next section to predict 1974 values of size of departments and 1972 total funds available to experiment stations excluding fees and sales.

All equations are estimated in linear form on cross-sectional data with

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[6] Since we have no *a priori* knowledge of the length of lag between change in the dependent variables and the consequent effect on the independent variables, two other alternatives were tried: 1961–62 and 1963–65. For most of the equations slightly higher R^2's were obtained using the longer 1968–60 lag, although the improvement over the other lags was negligible. The decision to use the 1958–60 lag was based mainly on convenience. With the longer lag it is possible to predict further into the future, with the prediction equations of the next section, without adjusting the coefficients.

48 observations. The variables used in each equation and the results are presented in Table 3. Values in parentheses are "*t*" ratios.

Table 3. Regression results on funds available and department research and teaching personnel

Dependent variable[a]	Constant	1958–60[b] Farm income ($mil)	1958–60[b] Nonfarm income ($bil)	1958–60[c] Related prod. ($mil)	1960 Dep. variable	R^2
1. a. Total Funds Available ($1000)	860.	6.07 (6.38)[d]	230. (6.37)			.790
b. Total Funds Available ($1000)	59.1	−1.21 (−1.61)	73.0 (3.38)		1.50 (12.2)	.952
2. a. Federal Funds Available ($1000)	627.	.798 (5.02)	14.2 (2.36)			.567
b. Federal Funds Available ($1000)	−19.1	.066 (1.52)	2.41 (1.73)		1.55 (29.5)	.979
3. a. Non-Federal Funds Available ($1000)	232	5.26 (5.42)	215. (5.85)			.746
b. Non-Federal Funds Available ($1000)	60.3	−1.10 (−1.63)	74.4 (3.64)		1.46 (12.7)	.946
4. a. Agricultural Economics (*R*+*T* personnel, 1967)	10.8	.021 (5.10)	.468 (3.02)			.609
b. Agricultural Economics (*R*+*T* personnel, 1967)	2.05	.004 (.915)	.305 (2.36)		.878 (5.00)	.751
5. a. Agricultural Engineering (*R*+*T* personnel, 1967)	5.62	.028 (7.08)	.136 (.898)			.637
b. Agricultural Engineering (*R*+*T* personnel, 1967)	.139	.006 (1.68)	.011 (.117)		.957 (8.92)	.871
6. a. Entomology (*R*+*T* personnel, 1967)	3.43	.031 (4.79)	.726 (2.96)			.586
b. Entomology (*R*+*T* personnel, 1967)	1.30	.002 (.556)	.209 (1.62)		1.01 (11.9)	.902
7. a. Agronomy (*R*+*T* personnel, 1967)	13.0	.042 (8.13)	−.409 (−2.11)			.616
b. Agronomy (*R*+*T* personnel, 1967)	12.8	.036 (3.53)	−.369 (−1.80)	.005 (.633)		.620
c. Agronomy (*R*+*T* personnel, 1967)	.220	.012 (1.98)	−.160 (−.141)	.003 (.695)	.952 (10.3)	.890
8. a. Animal Husbandry (*R*+*T* personnel, 1967)	7.86	.025 (8.40)	−.021 (−.181)			.678
b. Animal Husbandry (*R*+*T* personnel, 1967)	7.61	.020 (4.49)	.048 (.404)	.008 (1.81)		.700
c. Animal Husbandry (*R*+*T* personnel, 1967)	2.63	.016 (5.04)	−.122 (−..40)	−.001 (−.129)	.618 (6.67)	.853

[a] Data source for funds available: USDA, "Annual Report of the Experiment Stations," 1960 and 1966.

[b] Data source: *Statistical Abstract*, selected years.

[c] Related output for each discipline is:
Agronomy: value of field crop production
Animal Husbandry: value of livestock production
Dairy: value of dairy production (milk)
Horticulture: value of horticultural production including flowers, citrus fruits, and potatoes
Poultry: value of eggs, broilers, turkeys and chickens produced
Soils: value of field crop plus horticultural production
Plant Pathology: value of field crop plus horticultural production
Data source: *Agricultural Statistics*, selected years.

[d] Values in parentheses are "*t*" ratios.

Table 3. *(Continued)*

Dependent variable[a]	Constant	1958–60[b] Farm income ($mil)	1958–60[b] Nonfarm income ($bil)	1958–60[c] Related prod. ($mil)	1960 Dep. variable	R^2
9. a. Dairy Husbandry and Industry ($R+T$ personnel, 1967)	6.90	.002 (.573)	.386 (2.81)			.232
b. Dairy Husbandry and Industry ($R+T$ personnel, 1967)	5.94	−.002 (−.787)	−.039 (−.295)	.047 (5.43)		.540
c. Dairy Husbandry and Industry ($R+T$ personnel, 1967)	.871	−.003 (−1.66)	−.086 (−1.20)	.019 (3.57)	.811 (10.5)	.870
10. a. Horticulture ($R+T$ personnel, 1967)	3.39	.018 (2.96)	1.35 (6.01)			.659
b. Dairy Husbandry and Industry ($R+T$ personnel, 1967)	6.53	.003 (.663)	.894 (6.26)	.064 (9.14)		.882
c. Horticulture ($R+T$ personnel, 1967)	.132	.002 (.531)	.107 (.664)	.013 (1.32)	.915 (6.35)	.939
11. a. Plant Pathology ($R+T$ personnel, 1967)	4.49	.026 (5.87)	.410 (2.46)			.628
b. Plant Pathology ($R+T$ personnel, 1967)	4.37	.042 (2.46)	.404 (2.42)	−.012 (−.969)		.636
c. Plant Pathology ($R+T$ personnel, 1967)	2.03	.012 (1.17)	.136 (1.36)	−.005 (−.745)	.836 (9.48)	.882
12. a. Poultry ($R+T$ personnel, 1967)	4.05	.006 (2.38)	.136 (1.50)			.262
b. Poultry ($R+T$ personnel, 1967)	2.63	−.003 (−1.19)	.037 (.538)	.069 (6.39)		.617
c. Poultry ($R+T$ personnel, 1967)	.268	−.003 (−1.85)	−.070 (−1.44)	.039 (4.61)	.760 (7.14)	.825
13. a. Soil Science ($R+T$ personnel, 1967)	6.36	.029 (7.66)	.069 (.481)			.656
b. Soil Science ($R+T$ personnel, 1967)	6.34	.031 (2.13)	.068 (.470)	−.002 (−.157)		.657
c. Soil Science ($R+T$ personnel, 1967)	3.43	.012 (1.04)	−.008 (−.068)	−.005 (−.589)	.892 (5.71)	.805

In view of the many factors that could be expected to influence the size of experiment stations and departments, and considering that cross section data are used, it is a little surprising that the two income variables alone account for such a large share of variation in size. This is evident in regression one, for example, where 79 percent of the variation between states in total funds available to experiment stations is explained by variation in farm and nonfarm income between states.[7]

It is also a bit surprising to see the negative coefficient, although not significant, on the farm income variable in equations 1b and 3b (the total funds available and nonfederal funds available equations with the 1960 dependent variable included). This means that from 1960 to 1966, in terms of growth, colleges of agriculture and experiment stations in highly agricultural states fell behind those in the urban-industrial states. In other words, it was somewhat a detriment for an agricultural experiment station to be located in an agricultural state during this period. The main reason, of course, is that income seems to be the important variable explaining experiment station growth, and income is highest in the urban-industrial states.[8]

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[7] For previous work on factors influencing funds available to experiment stations, see [6].

Total and nonfederal funds available, *including* fees and sales, were used also as dependent variables (not shown in Table 3). In this case, the farm income coefficient was positive, although not significant, in equations comparable to 1b and 3b. Apparently, the experiment stations in agricultural states rely more heavily on fees and sales as a source of funds than do those in urban-industrial states.

The same general findings are obtained when rural farm population and non-farm population are used as dependent variables in place of farm and nonfarm income (not shown in table 3). In this case, rural farm population does not enter as a significant variable in the equation even when the 1960 value of the dependent variable is not included (equations comparable to 1a and 3a). The coefficients, *t* ratios, and R^2 for these equations are:

Dependent variable	Rural farm population (thousands)	*Nonfarm population (thousands)	R^2
Nonfederal funds available ($1,000)	1.07 (.722)	.683 (7.66)	.622
Total funds available ($1,000)	2.46 (1.66)	.725 (8.11)	.671

* Includes urban plus rural nonfarm population. Values in parentheses are *t* ratios.

In summary, it appears that farm income is a better predictor of nonfederal and total funds available than farm population, but neither is as good as nonfarm income. These results should comfort those who have feared a decline in support of colleges of agriculture and experiment stations because of the decline in number of farmers. The important variable seems to be number of dollars of income in the state rather than number of farmers.

With reference to the departmental equations, it is likely that higher R^2's would have been obtained had expenditure figures been available for the dependent variables instead of personnel numbers. It is reasonable to expect that the richer states pay higher faculty salaries and spend more on supporting facilities and personnel.

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[8] For previous work on the relationship between farm and industrial states and their support of agricultural experiment stations, see [5, 1].

Some interesting contrasts come into focus with respect to the relationship between deparement size and the two types of income. Considering equation "a" in each of the departmental regressions, farm income enters as a highly significant variable for all departments except Dairy. Using size of "t" values as the criterion, Animal Husbandry, Agronomy, Soils, and Agricultural Engineering seem to exhibit the closest relationship to farm income, although the remaining departments, except Dairy, rank fairly close behind. About the same relationship holds true if we use size of coefficient as the criterion.

More diverse results are observed for the nonfarm income variable, however. The departments with the closest positive relationship to nonfarm income appear to be Horticulture, Agricultural Economics, Entomology, and Plant Pathology. It is of interest to note that two departments in the "a" series of equations bear a negative relationship to nonfarm income: Agronomy and Animal Husbandry. Moreover, for Agronomy the coefficient is significant at the .01 level.

In the "b" equations of regressions 7 and 13, the value of farm production that would seem to be closely related to the department is introduced.[9] This variable enters at the .01 significance level for Horticulture, Poultry, and Dairy. One might expect this result in view of the relatively active and cohesive producer groups representing these industries.

As might be expected, the inclusion of the 1960 value of the dependent variable in the regressions reduces both the size and significance of the coefficients on the income and related farm production variables. Also, this variable seems to exhibit relatively more strength in the experiment station regressions (1 through 3) than in the individual department regressions. This would indicate a greater change in relative size of individual departments between states during the 1960–67 period than for the entire experiment station. The greatest stability of relative size is observed in the federal funds available regression. This might be expected in view of the formula method of allocation.

To summarize the results thus far, we might rank the departments according to the strength of their relationship with income and related production in the following manner:

Closest relationship to farm income	Closest relationship to nonfarm income	Closest relationship to related production
Agronomy	Horticulture	Horticulture
Animal Husbandry	Agriculture Economics	Poultry
Soil Science	Entomology	Dairy
Agricultural Engineering	Plant Pathology	

Generally, it appears that departments with a close orientation to agriculture at the farm level bear the closest relationship to farm income, whereas those departments having a closer contact with the nonfarm sector of the economy seem to be more closely tied to nonfarm income. We might conclude, therefore, that the four disciplines in the first column will find the most favorable climate for growth in the more predominate agricultural states and that those in the second column will fare best in the urban-industrial states. Since the latter states will likely experience the most growth in income, the climate for future growth would seem to be most favorable for these four disciplines. It would appear also that the disciplines in the third column, particularly Dairy and Poultry, will become more consolidated, growing in the states with large poultry and dairy industries and declining in the others.

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[9] The specific values used are listed at the end of Table 3.

These results imply further that the degree of support by the farm and nonfarm sectors for each discipline seems to depend on the degree of contact between the discipline and each sector. For example, nonfarm people seem to be more willing to support the disciplines they know about and have contact with, namely, the four in the second column. Although plausible, this is somewhat unfortunate because there is no reason to believe that more direct contact or relationship between a discipline and a sector also means greater benefits for that sector. The research output of the more farm oriented disciplines, Agronomy and Animal Husbandry, for example, also benefit the nonfarm sector by making it possible for agriculture to produce food more efficiently and cheaply and for labor to leave agriculture to produce other things. Because of the more remote relationship between the more farm oriented disciplines and the nonfarm sector, their future support from the nonfarm sector will depend largely on how well these disciplines inform the nonfarm public about the relationship between their research and consumer welfare. Of course, agricultural economists share this responsibility also.

Predictions for the 1970's

More specific predictions of future growth and decline of experiment stations and individual departments can be obtained by using the equations presented in Table 3. The coefficients utilized are those in the "b" equations of regressions 1, 4, 5, and 6, and the "c" equations of regressions 7 through 13. As we know, departments do not fluctuate in size a great deal; because of tenure of faculty and other institutional factors, year to year changes can at most be marginal. In view of this, it seems expedient to use the equations which incorporate the information given by the 1960 dependent variable.

In order to use the coefficient on this variable without adjustment, predictions are made into the future by the same number of years that exist from 1960 to the year of the dependent variable in Table 3: 1966, for total funds available, and 1967, for the individual departments. Thus, the predicted values obtained will be for 1972 for total funds and 1974 for the individual departments.

The length of lag for the income and farm production variables is assumed to be the same in the prediction equations as in the equations of Table 3. That is, 1967 values of these variables are used in the prediction equations. Because published data on state 1967 values of farm and nonfarm income and the various categories of farm production are not yet available, these figures are estimated by fitting a least squares trend line to the 1958-1965 observations of these variables for each state and extrapolating two years to 1967. All money values are deflated by the consumers price index, 1960 = 100, to take out the trend caused by a rising general price level.

The predicted values of 1972 total funds available and 1974 number of research and teaching personnel in each discipline were obtained for each state. However, because of space limitations these figures are aggregated into the nine USDA regions and presented in Table 4.[10] As in any other prediction, one should, of course, take these figures with "a few grains of salt." Nevertheless, it seems that they do indicate where pressure for growth or decline will be greatest.

As we might expect from the regression results obtained, those disciplines bearing the closest relationship to nonfarm income are predicted to experience the most growth, especially in the urban-industrial states. There is one exception, however. Soil science, although closely related to farm income, is among the higher growth disciplines. A possible explanation is the rapid suburbanization occurring in most states, which requires knowledge of soils and soil mechanics for construction of foundations, drainage facilities, streets and highways, etc.[11] As a result, the coefficient on the 1960 dependent variable carries relatively large weight in this equation because of the general upward trend in size of most soils departments during the 1960-1967 period. Consequently, the model comes close to being just a linear trend projection for this discipline in each state.

In the aggregate, only two disciplines—Dairy and Poultry—are predicted to decline from 1967 to 1972. It would be misleading, however, to conclude that these disciplines will decline in all states. Growth is predicted for these in states where the related industries are large and growing. By the same token, it would be misleading to conclude that the remaining disciplines, which are predicted to grow in the aggregate, will grow in every state. In fact there are only two—Agricultural Economics and Soils—for which growth is predicted in every state. Even with these,

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[10] Detailed state data may be obtained from the author upon request.

[11] I am indebted to Professor Bonnen for this suggestion.

Table 4. Observed and predicted values of total funds available and departmental personel by regions[a]

USDA Region	Total funds avail.[b]	Ag. econ.	Ag. eng.	Agron.	An. hus.	Dairy	Ent.	Hort.	Plant path.	Poultry	Soils
	($mil.)	....	....	....	....	Number of personnel	....	....	....	....	....
NE											
Observed 1967	7.9	52.6	30.5	30.2	33.2	23.8	35.2	38.5	32.7	25.7	25.2
Predicted 1974	13.7	67.7	30.9	28.9	36.9	26.1	49.3	41.4	45.0	25.0	44.8
MA											
Observed 1967	20.7	80.5	44.2	51.3	42.0	58.7	81.7	107.7	62.8	33.0	49.5
Predicted 1974	36.9	107.1	48.1	42.7	34.3	55.9	106.6	114.4	75.8	26.3	58.7
ENC											
Observed 1967	32.7	187.4	93.7	131.1	106.4	107.3	104.4	110.3	92.9	41.2	118.2
Predicted 1974	53.1	212.3	105.9	129.1	105.2	102.0	136.0	121.6	108.5	31.8	130.2
WNC											
Observed 1967	28.2	175.0	129.1	216.7	146.6	92.4	98.1	82.4	98.7	37.1	157.2
Predicted 1974	40.1	190.5	145.3	229.1	157.9	84.3	121.5	87.9	116.0	31.8	179.4
SA											
Observed 1967	31.8	164.7	145.9	164.0	122.8	69.4	171.7	165.7	150.9	69.9	133.1
Predicted 1974	49.1	180.5	153.8	169.8	124.0	61.5	197.9	172.4	161.0	80.4	157.5
ESC											
Observed 1967	15.5	69.3	75.2	108.7	63.3	39.7	38.0	49.5	40.7	25.7	50.7
Predicted 1974	23.1	80.1	81.3	114.3	70.1	35.6	50.0	51.8	53.6	34.4	67.9
WSC											
Observed 1967	20.1	97.7	79.4	142.7	85.0	32.4	112.2	74.2	83.7	41.7	77.0
Predicted 1974	30.2	111.5	89.0	148.5	91.0	26.6	129.1	78.6	93.1	43.4	92.9
M											
Observed 1967	16.3	97.9	72.0	186.2	106.2	35.2	82.0	60.2	59.9	22.0	105.2
Predicted 1974	24.7	110.4	76.1	185.4	100.2	35.1	98.1	63.9	72.7	17.6	125.7
P											
Observed 1967	32.3	69.7	86.7	127.0	68.1	19.5	146.7	153.4	122.7	28.7	68.0
Predicted 1974	50.5	91.8	94.9	131.1	72.0	18.2	167.5	172.6	124.0	27.7	78.2
U.S. Totals											
Observed 1967	205.5	994.8	756.7	1157.9	773.6	478.4	870.0	841.9	745.0	325.0	784.1
Predicted 1967	205.2	990.2	755.6	1158.0	771.9	478.2	870.2	841.8	745.2	325.2	784.0
Predicted 1974	321.4	1151.9	825.3	1178.8	791.6	445.3	1056.0	904.6	849.7	318.4	935.3
Change 1967–74	+115.9	+157.1	+68.6	+20.9	+18.0	−33.1	+186.0	+62.7	+104.7	−6.6	+151.2

[a] Regional and U.S. totals were obtained by summing the figures for individual states.

[b] For this variable only, the observed and predicted values are 1966 and 1972, respectively, instead of 1967 and 1974. Value figures are constant 1960 dollars. Consumer Price Index used as deflater. Excludes fees and sales.

growth in several states is predicted to be quite small. The main point to be made here is that growth in the aggregate does not mean growth in every state. The same is true, of course, for decline.

Summary

The main emphasis of this paper has been on "what is" as opposed to "what should be" with regard to the allocation of research, teaching, and extension personnel in U.S. land grant colleges and experiment stations. As expected in public institutions staffed by personnel with lengthy, specialized training periods, year to year changes come about rather slowly and are marginal in size. Although growth is the predominate characteristic at both the discipline and individual department level, we observe and can predict future decline, particularly at the departmental level within several of the disciplines.

Among the variety of factors that probably influence the size of experiment stations, state income, both farm and nonfarm, emerges as the important variable. Farm population of the state appears to a relatively minor factor affecting nonfederal and total funds available to the state's experiment station. The number of dollars of income generated in the state, not the number of farmers, seems to be the important variable determining the support of experiment stations. Moreover, in recent years, nonfarm income has become more important than farm income in explaining experiment station support. This trend will likely continue as the nonfarm sector grows relative to the farm sector of the economy.

The relationship between individual departments and farm and nonfarm income is more diverse. The departments that appear to have a more direct contact with nonfarm people bear a closer relationship to nonfarm income than the departments with a greater farm level orientation. This implies a rather unfavorable climate for future support and growth for the latter departments unless the nonfarm public becomes aware that even farm oriented research benefits consumers ultimately.

The approach of this paper and the results imply a rather deterministic view of research allocation. One could argue, of course, that administrators in colleges of agriculture and experiment stations have at least some power to determine the destiny of their institutions. Although this may be true, each has to operate within funding constraints and these constraints appear to be defined largely by the magnitude of income in the state. However, funding constraints become a greater problem only if administrators really attempt to reallocate the distribution of research, teaching, and extension in their institutions. But the stability of relative shares suggests that tradition and rule of thumb may be preferred to the more difficult process of problem-oriented decision making.

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Production Economics, Farm Management, and Extension[*]

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Perusal of the literature of agricultural economics and some exposure to the work of personnel engaged in agricultural extension suggest the need to review relationships between the disciplines of production economics, farm management, and extension. This need arises because each of the disciplines might be expected to have significant effects on the scope, methodology, and usefulness of the others. My purpose is to try to set in perspective some of the differences in viewpoint that have emerged between different participants in agricultural economics and agricultural extension. This perspective may help to point the way to release from some aspects of the new orthodoxy within agricultural economics, whic is discussed in the paper.

The Problem in its Setting

WHATEVER the scope of production economics may be, the scope and purpose of extension, I assert, differs from that of production economics because its primary purpose is educational, and it is based on a wider range of disciplines than economics alone. Production economics is one, but only one, of the basic disciplines for both farm management and agricultural extension. On the applied side, farm management extension is one, but only one, of the components of agricultural extension.

Despite this common ground, the interchange between production economics and agricultural extension has so far been largely a one-way flow of influence and information. Economists have sought to apply their principles in farm management extension. But many of the problems encountered in day-by-day extension programs have had little effect on the immediate purposefulness of production economics, although they have influenced its scope.

One is therefore led to a second assertion: there has been a breakdown in communication between personnel in the basic discipline of production economics and personnel in the applied science and art of agricultural extension. Each of these fields has been evolving at a different pace and in a different way, with different basic skills, different purposes, different per-

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[*] This paper had its origins in a plan, initiated in 1964 by one of Professor Earl Heady's followers, to edit a volume of essays on production economics in the 1960's to be written in honor of Professor Heady. This paper was to cover the field of production economics in relation to extension, but the plan to produce the volume was not fulfilled. My thanks for comments on earlier drafts are recorded to A. C. Egbert and B. L. Lanpher and to A. Lloyd, N. Sturgess and T. MacAulay. J. Dunbar and R. L. Mighell also made helpful comments and suggestions.

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sonnel, and as part of the activities of different institutions—without much interaction between their mainstreams of scientific discipline and folklore.

The failure of extension and farm management to exert a more active influence on the scope and purpose of production economics has been an important feature of agricultural economics during the past twenty years. It reflects in part the persuasive nature of Earl Heady's leadership in establishing a new framework for production economics. But other influences as well have hindered the shift in focus of interest within production economics toward the experience and problems of extension. Among these has been the failure of Heady's colleagues to keep his contribution in perspective and to rise above and beyond his magnificent insight so as to realize the implications and the limitations of his new orthodoxy.

Still other important influences are the institutional arrangements under which the disciplines of economics and extension are organized in different countries [17].

From Production Economics to Extension

Production economics, if it has standing as a discipline, is comprised of principles and concepts that provide for interpretations of the economic relationships existing among resources used in individual firms. Once defined, these principles and concepts should find universal application; if they fail to do so, production economics loses claim to status as a separate discipline. Unfortunately, this failure often has occurred whenever production economics has assumed that the institutional structure of farming —not to mention the human nature of farmers—is a neutral umbrella which can be added as a superstructure to the model or principles without becoming an integral part of them. Thus, it would appear that production economics so far has not formalized a set of principles that takes account of differences in motives, behavior, and institutions between different countries, or different regions within countries.

Farm management, by contrast, is an applied discipline that finds its identity in relation to the whole set of established social institutions and to the structure of farming in a given country. It is designed to develop principles that provide understanding of agricultural practice and managerial performance, as an aid to individual farm enterprises and as a basis for agricultural policy. It links the disciplines of production economics and agricultural extension, though it does other things as well.

When one turns to extension, the difficulties of identifying a separate discipline are greater. This is so because an element of art and intuition is involved in educational processes and because the processes of education within societies are founded on some comprehension of a wide range of social and individual behavioral disciplines. Furthermore, the form and scope of extension differs greatly between countries. Even more than farm management, extension takes its form from the institutions of which it is a part and from the social traditions which mold the attitude towards education and economic or social change of people in the culture concerned. For example, the emphasis given to different sectors of the rural community—commercial farms, subsistence farms, rural youth, farm wives—varies according to the degree of association between extension and government development programs, as well as the scope of other adult education services.

Experience over the years in the United States has shown that extension has been a significant component of the armory used to tackle rural problems [14]. Farm management has tended to maintain close association with cooperative extension service programs, and the links between these two have been a feature of the Cooperative Extension Service from its earliest days, especially during the last 35 years.

In the United States, the farm management orientation in extension has placed emphasis on decision-making. But, somewhat ironically, the problems involved in decision-making lead far beyond the scope of production economics, at least beyond its scope as it has so far developed as a professional discipline. Ruttan [15, p. 1494] spells out this point clearly when he discusses the implications of accepting production economics as "simply one of the applied behavioral, social, biological, and physical science disciplines upon which farm management is based. . . ."

Changes in progress within the Cooperative Extension Service have far-reaching and fundamental implications for the land-grant colleges, which infused the educational component into extension. The implicit but emerging conflict between the Cooperative Extension Service as a government agency and its role as an educational organization must be expected to have repercussions on the scope of farm management extension. Pressures are growing for extension to become less concerned with the welfare of farmers *per se* and more concerned with the relations of farm industries to productivity of the economy as a whole. Increasing emphasis is placed on specific audience groups such as rural youth, commercial farmers, or part-time farmers, as well as urban groups and marketing firms.

Despite these important changes, the United States extension scene still reflects its well-entrenched management component. Farm management has been an established discipline in land-grant colleges for many years, with its extension and research specialists. In a dynamic society where changes in occupations and land use are in progress—both are necessary components of economic growth—farm management principles can help to interpret changes and point to the feasibility of change as a basis for extension programs.

Recent reviews by Camm [4], Davies [7], and Giles [8] indicate the difficulties being met in bridging the gap in the United Kingdom between different disciplines and between research and advisory activities. Davies reports that too much emphasis has been placed on descriptive analysis and stresses the need to define problems precisely, in order to move into the problem-solving stage. This requires closer co-operation with the natural sciences, not only by research workers but by advisers, particularly at the initial planning stages when problems are being defined. The research results eventually obtained can then be comprehensible to both extension agent and farmer.

Camm acknowledges that most of the sophisticated and complicated farm management research techniques are "beyond the grasp of advisers and unintelligible to farmers" [4, p. 27]. He suggests the gap between theory and practice is such that research in communications, in day-to-day farm management, and in managerial capacity would help to raise the efficiency of farming. In the communications field, he outlines the need for more effective two-way communication between the farmer and the adviser, and between advisers and research workers.

Giles, writing from the viewpoint of a farm management liaison officer, mentions the failure to achieve widespread understanding among U.K. farmers of even the simplest economic concepts. In part this arises from a tendency by agricultural economists to write "with one eye on the industry we hope to influence and one on professional reputation" [8, p. 36].

For many years, the simple principles underlying the economic structure of farm firms, input-output relations, or opportunity costs have found application in farm management. But, as Butcher [3, p. 1476] has suggested, "It is the principles, not the precision, of production economics that have proven most useful in these applications." In any case, partly because of the problem of language and the inability of extension personnel to cope with new concepts, it is not easy to point to new empirical research findings or even to new principles contributed by production economists that show promise of, or have activated, important day-by-day application in farm management extension programs. Perhaps it will be ever thus. If so, there are significant implications for both farm management and agricultural extension.

For example, we might stop worrying about the fact that production economists are not practical and let them go their way, exploring as and where they will. To do so might be feasible, at least here in Australia, if two conditions were met. First, farm management and agricultural extension personnel would need to be of high caliber and well trained, capable of making their own gleanings and interpretations of the intellectual activities of production economists. Second, and equally important, production economists would have to "play it fair" in terms of competition for status and for the financial support attracted by this status.

Since this is too much to ask (though I do so later), we are tempted—

or even forced—to turn aside from this unreal world; and like Kelso [12], we continue to worry about the low scientific predictability of agricultural economics. Yet we should realize that this implicitly demands that we do not accept a low direct payoff in the applied extension field from work in production economics.

Implications of Production Economics Methodology

In 1963, as part of his analysis of changes in the United States since 1952, Glenn Johnson identified the widening gap between production economics and extension. He wrote:

> The proportionate use of farm management research by extension workers has decreased as its production economics orientation has increased. This is associated with:
>
> (a) decreased relevance in practical farm management problem situations of much of the current production economics research in farm management; and
>
> (b) the failure to increase competence with respect to production economics as rapidly among extension as among research farm management workers . . .
>
> 'Production economics' oriented farm management workers have either largely ignored or been largely ignored by the editors of the Journal of Farm Managers and Rural Appraisers, whose supporting association and membership have maintained a keen interest in the practical problems of farmers. [10, p. 17].

Production economics has made a major contribution in the field of public policy as a guide to the interpretation of supply responses by different industries and from different regions. This role, which first found its full expression in the United States adjustment programs of the 1930's, has continued to be the heart of applied production economics over the years. Adjustment problems may arise from a market collapse, as in the United States in the 1930's; from war, as in the United Kingdom in the 1940's; from pressure on balance of payments, as in Australia in the early 1950's; or from changes in the rural sector through new trade arrangements and economic growth centered in the industrial sector, as in Europe in the 1960's.

In developed countries where production economics has flourished, there has been much emphasis in recent years on economic growth and on the effects of various protection and price support programs. This has drawn attention away from the institutional structure of rural industries, away from imperfections in markets for factors of production, and away from the analysis of the significance of differences in the structure of farming and the technical and commercial services associated with rural industries. Yet these are the very aspects of farming that extension programs need to take into account, as specialist consultants from developed countries have learned to their cost when called upon to assist in development programs of undeveloped countries.

This shift of emphasis towards problems of economic growth and the relations of the rural sector to growth of the whole economy once again seems to have enabled production economics to turn aside from the critical problems of individual motivation and preferences that underly behavior and might provide a more formal basic discipline for extension personnel. One would be foolish to deny the importance of the new emphasis on economic growth; but one must also point out that when the time comes to bring into practice—within extension programs—some of the policies which emerge from the macro-analyses, much more knowledge of the problems and behavior of individual farms and of farmers will be needed. Production economics has not yet provided an adequate framework to interpret and apply this knowledge.

Much of the "prideful development" in agricultural economics described by Kelso bears on the contributions of production economics to aggregate problems and to methodology, rather than to improved understanding of individual farms. Kelso considers that:

> Most of the remarkable current developments in agricultural economics equip us only to be more exact, more positive, more quantitative, more complex in our rationalistic analysis of hypothetical, simplified, imaginary systems from which man—as a partly irrational, unpredictable, emotional animal—is banished, to be replaced by the lightening calculator in human form. [12, p. 5].

The new methodology has provided means of identifying relations within specified systems, even if the variables used are not always ideal as a measure of the real world situation; when it comes to the real world, we cannot even be sure that the questions posed and answers provided by economists, restrained as they must be by the limits of scope and of definition implicit in their models, are the important questions and answers. The models do not imply the important questions because they exclude important variables, such as those relating to behavior and to institutions —often because these can't (yet?) be quantified by traditional mathematical methods. In Kaplan's phrase, much effort is vitiated by the principle of "the drunkard's search" [11, p. 11]. The drunkard searches under a street lamp for his house key which he had dropped some distance away. Asked why he doesn't look where he had dropped it, he explains, "It's lighter here."

As economic growth proceeds apace, the institutions associated with farming—land tenure, contract services, credit, and marketing arrangements—may also change rapidly. Farm management workers and extension officers are involved in and participate in these changes. The production economist fails to serve their needs if he conducts his analysis within a framework that abstracts from the relations between institutional factors and the best allocation of resources.

It makes little difference whether the resource allocation be best in terms of the welfare of the rural sector or of economic growth of the whole economy. In either case the analysis is incomplete unless the production economist takes account of the existing institutional restraints and considers how growth or change or new policies may influence them; he must also weigh how farmers will respond to changes in factor prices within the evolving institutions that also may be a part of economic growth. Superimpose on all this the effects of extension education on the farmer's technical efficiency, on his use of institutions, and on the values and preferences that underly his behavior patterns—and some comprehension can be obtained of the complex interaction between production economics and extension education.

None of this is to deny that much of the information provided by production economists is helpful to the farmer. So, too, is the analytical framework which embraces diminishing returns, opportunity costs, rates of substitution between inputs and between outputs, and so on. But, from the extension educationists' viewpoint, there is need to interpret these principles to meet the circumstances of farmers as individuals or as groups. Moreover, extension specialists have a responsibility to communicate effectively about the nature of problems encountered in extension and agricultural practice and to specify the parameters needed for the improvement of farmers' decisions. It is in the interpretative phase that communication between extension and production economics has so far frequently been found lacking—not so often because production economics is wrong within its own limits, but because its limits are inadequate and because its interests are elsewhere. As a result, it provides only a partial explanation of the economic aspects of human organization and activity and says even less about the social and wider behavioral aspects.

Production economics provides an internally consistent logic by which it defines the systems and conditions for optimum economic use of resources. For those who are fond of such exercises, there is intellectual satisfaction and delight in the establishment of models and the successive release of restraints so as to analyze relations and interactions in ways that purport to give some understanding of the real world.

However, when assessing the scope and adequacy of the models, a fundamental methodological problem is involved. When models are used to interpret real situations, the scientific discipline, providing for comprehension of relations within the model, gives way to interpretation and insight which breaks away from the formal guidelines of scientific method. It is about the methodological implications of this process of interpretation and insight that we are so ignorant. Conklin saw this clearly when he wrote, in 1960:

> On the human side also, we usually ignore factors that determine how our recommendations will be received . . . [6, p. 1480].

And again:

> Some claim that the job of tailoring recommendations to men and institutions is the job of extension personnel. This is the way, of course, in which we have avoided facing up to the limitations of the image of the world we have been using. Anything that does not fit the deterministic mechanical mould is pushed off into extension, or policy, or some other fuzzy area where the workers do not have exalted scientific ambitions. [6, p. 1481].

To me, it is somewhat unsatisfying to use these models as a starting point, successively releasing restraints and adding 'real world' assumptions in order to achieve some comprehension of this real world. What if the restraints interact with one another? Starting from the other end, if some brave omniscient could conceive of the many human and institutional interactions and relations in the real world and then proceed to simplify these by removing variables one by one so as gradually to make them more akin to our models, would he meet in the middle with those present-day production economists who move away from their models by the successive release of restraints?

I suspect that human activity and systems of organizations are not yet amenable to so-called scientific analysis based on quantitative analytics alone, if understanding rather than predictive power is the purpose of our inquiry. While predictive power is one of the legitimate purposes of scientific inquiry, one must strive for a higher order of understanding as a basis for the educational programs to which extension officers devote their professional efforts.

Perhaps this is an underlying cause of problems referred to by Kiehl, when he writes of the younger workers in extension who are forced into a "research Ph.D. mold" and are thereby led to overlook the tremendous educational opportunity with lay people.

> Part of the high attrition among younger workers, no doubt, is due to the inherent result of present Ph.D. programs tending to engender personal aggrandizement in new-found research of theoretical skills. Somehow some have lost their 'educational touch' and embarked on a personal program of emphasizing their newly acquired competence. [13, p. 1456].

In the meantime, those concerned with practical problems need courage and support to move beyond the evanescent prevailing concepts of scientific method. It is part of the history of agricultural economics that such courage and support has not always been evident, and so an inbuilt orientation has evolved in our profession towards "scientific" production economics rather than towards "unscientific" farm management and extension. Using concepts to solve problems, too often we have become so interested in concepts that we have lost sight of the problems.

In the United States—and in Australia too—the gap between production economics and farm management, which showed such promising signs of narrowing a decade ago, has now widened. Production economics has turned more and more to research methodology and policy implications, while farm management extension has remained as empirical as ever, face-lifted though it has been by some help from computers to do the arithmetic involved.

Among production economists—and here I have in mind particularly those of the United States, United Kingdom, and Australia—the growing emphasis on uncertainty and on inter-disciplinary approaches to input-output analyses on the biological side, and to decision-making and behavioral studies on the social sciences side, has all been well-meaning enough. But these new efforts have not yet paid off in terms of their influences upon practitioners of either extension or farm management.

Nor have there been great advances within farm management. Can we record significant changes in knowledge or concepts within problem areas, such as classifying farms on a more meaningful economic basis, getting access to farm data, interpreting farm costs, analyzing different components of farm income, and measuring management inputs, or in the problems of spreading capital costs over time?

Progress has been slow in devising new concepts within production economics that have an application in farm management practice. The use of well-worn farm management principles—mainly diminishing returns and opportunity costs—is proceeding apace, simply because of the need to solve problems that press for attention. Yet there is also enough difference between and within countries to enable the scope and technique of farm management extension to gain from efforts to apply more widely what is already known, however intellectually unsatisfying this may be to some.

An important comment is made by Ruttan [15, p. 1492], when assessing the significance in the late 1940's and early 1950's of the "intellectual challenge associated with the developments in economic theory and quantitative method . . ." He proceeds to state what surely is a counsel of despair:

> I do not expect to see this challenge duplicated in the immediate future. Indeed, I would argue that economic theory and the related quantitative disciplines are experiencing a period of consolidation and refinement rather than a new burst of insight at the present time.

Far less than meeting the challenge, this statement fails even to acknowledge it, at least as a component of "economic theory and the related quantitative disciplines." What was that about a drunkard's search?

My own somewhat heretic belief is that constant empirical busyness, as well as efforts toward a wider application to new extension problems and situations founded on but not limited by known economic principles, will create a situation in which original minds will gain insights that may well be lost to others concerned with more abstract relations and principles. I have a suspicion that the Iowaites do this too, but won't admit it (much less publish it), and feel bound to pay homage to a methodology that stresses the quantitative analytical deductive method. Whatever may be the merit of their economics, one is compelled to admire their gamesmanship, which so often appears to impose intellectual obsolescence on their blood brothers in farm management extension. Conform or be damned, they say, and we'll be damned if we do.

Orthodoxy and Dissent

How ironic it is, here, now, in 1968, that so much of the new orthodoxy, which for two decades has linked farm management and production economics, leads us to see more clearly the confined scope of production economics and the need to rise above and beyond the constraints exercised by this discipline, if problems of the real world are to be tackled.

In retrospect, one may hope that the 1960's will be seen as the period when the influence of humanism in the sciences, including economics, matured. Heady's great contribution has been to provide a model that is brilliantly conceived but contains the seeds of its own destruction, because it abstracts from problems of human behavior and institutions and concentrates on resources as such.

It is not that anyone else has done better, nor that Heady has not been as much concerned with investment in human resources and economic development as the next man. But his contributions to methodology have tended to abstract from problems of behavior; and his subsequent interest in problems of economic development seems sometimes to depart from some of the restrictions of his own models and methods, which have been his heritage to the profession of agricultural economics. In problems of macro-theory, there is little of the formal elegance of his micro-economic models. This is at least circumstantial evidence that in the world at large something more is needed as an aid to the interpretation of and advice about individual farm problems.

Yet in 1952 Earl Heady, in Glenn Johnson's words, articulated in a remarkably accurate way the then prevalent mood of the members of the profession of agricultural economics [10, p. 16]. Indeed, this great articulation in the 1950's by its nature has led us to see more clearly the need for another such intellect to address himself to the new situation in 1968 and reveal how the restraints implicit in our accepted principles and beliefs have limited the form and the application of agricultural economics.

It is for the profession of agricultural economics to encourage the contributions that will render our own made-in-the-1950's kit of methodological tools intellectually obsolete. If, as Kelso argues, agricultural economics is indeed an art, then we should take account of the view of an historian of art as to the ways by which schools of art emerge and disintegrate. Collingwood says:

> To the historian accustomed to studying the growth of scientific or philosophical knowledge, the history of art presents a painful and disquieting spectacle, for it seems normally to proceed not forwards but backwards. In science and philosophy successive workers in the same field produce, if they work ordinarily well, an advance; and a retrograde movement always implies some breach of continuity. But in art, a school once established normally deteriorates as it goes on. It achieves perfection in its kind with a startling burst of energy, a gesture too quick for the historian's eye to follow. He can never explain such a movement or tell us how exactly it happened. But once it is achieved, there is the melancholy certainty of decline. The grasped perfection does not educate and purify the taste of posterity; it debauches it. [5, p. 11].

How much we need, as Schultz observes, a dialogue similar to that of a generation ago between farm management and agricultural economics to "bring the agricultural sector back into focus and to make our studies of the farm-firm more relevant" [16, p. 1010]. The new dialogue needs to be expressed in terms of economics and its application in farm management and extension, and to explore how, in this application, economics changes its form.

Such a dialogue also needs to pursue what Boulding, in his 1957 paper on institutional economics, has so aptly called "the general sociology of dissent" [2, p. 2]. Boulding identified himself with some of the discontent with orthodox economics expressed by the institutionalists. He wondered why in many different fields such as economics, religion, art, philosophy—indeed in almost every aspect of human life and thought—certain viewpoints or developments established themselves as orthodox or "mainstreams"; and why dissenters, with their pugnacity, shrillness, and asceticism, perceive themselves as dissenters not belonging to a mainstream of orthodoxy.

Boulding acknowledges "a somewhat despairing concern for dynamics in theory," and "a very strong concern for integration in the social sciences and for bringing contributions from psychology, sociology and the biological sciences into the construction of better theories of individual behavior and social change"; he also expresses "a strong (if skeptical) interest and sympathy with empirical methods" [2, p. 12]. Ayres, in commenting on Boulding's paper, identifies the dissent of the institutionalists as centering on the role of the market, which at most only gives effect to the prevailing institutions—the organizational structure of society that is the "real determinant of whatever allocation occurs in any society" [2, p. 26]. The institutionalists further argued the importance of the state of the industrial arts, which determines the relative scarcity or plentifulness of resources. All this seems to have a particular significance to the present state of agricultural economics, and especially to production economics.

Hildreth [9, p. 839] has made an attempt to set out hypotheses concerning the causes of tension between research and extension workers within agricultural economics. He suggests, in three alternative hypotheses, that tension is caused: by difference in orientation to variables of time and depth of analysis; by the different methods and supporting disciplines used by the two groups; or by different scholarly social circles of research and extension workers. Hildreth presents these hypotheses "to arouse discussion and thought which might lead to their evaluation," and recognizes that the precise testing of these hypotheses would be a major task. His approach implies that tensions of this kind are harmful ('disturbing') and that disparaging statements reflecting these tensions "tend to destroy self-esteem and mutual respect between research and extension workers, which are vital for the productivity of the profession." This statement is, indeed, yet another hypothesis which may need to be tested, for one might alternatively argue that from tensions of this kind, hard to bear though they may be, come some of the original breakthroughs in understanding within our profession of agricultural economics.

Another hypothesis worthy of test is that much of the responsibility for the default underlying the breakdown in communications between production economics and extension must be laid at the door of the extension profession itself. This is to say, until extension personnel communicate their needs (gaps in information; problems of interpretation of research findings) more explicitly and exert an influence on production economics, and until more resources are attracted to build up an analytical framework as a basis for the empirical methods now used in extension, many of our problems will persist.

Glenn Johnson has astutely argued the importance of the philosophical attitudes underlying the discipline of farm management; but his emphasis has retained an orientation towards research methodology, rather than the related problems of interpretation and application of research results in extension programs. In an interesting reaction to Johnson's analysis, Baker [1, p. 154] observes: "However, there is a sense of frustration too in Professor Johnson's analysis. The partitioning of the investigational field into positive and normative becomes most nebulous. More important, his conclusions lack definition on prescriptive proposals for research investigators. Instead, we are exhorted to be more useful." Baker then suggests

[1, p. 155] an ". . . alternative division of the investigational field. . . . Distinctions made by reference to models or data are at best ambiguous and at worst misleading. The distinction useful in research lies in the orientation of the whole research process, with special emphasis on perception of the problem and formulation of it for research, not in the specific model used in the research."

We need to expand these confrontations, starting from the basic philosophical foundations of economics, to explore production economics, farm management and agricultural extension. At each step in this exploration the purpose would be to identify how the use of models, the role of the human mind in developing propositions while also being the observer, and the changing status of human society as the subject for study, each exerts an influence on the information and attitudes contained in the ultimate end-point of extension education. That is, let us show how these successive steps all influence the nature and scope of information conveyed to farmers, and how they influence the technique of extension. If all this is old-hat to production economists, philosophers, or social scientists, it is surely time that one of them took pains to express the current state of each discipline in a form which reveals its implications to practitioners of other subjects and to pragmatists who have to solve problems in human welfare.

Such an exercise, directed towards a pragmatic purpose, may well reveal new contributions which the applied social sciences can make to scientific method itself.

In the real world, educational work with farmers has its place as well as quantitative analytics, and workers in neither field should have sole claim to orthodoxy within the profession of agricultural economics nor refrain from the shrillness, the pugnacity and the asceticism of dissent.

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An Aggregate Model of Agriculture—Empirical Estimates and Some Policy Implications*

ALVIN C. EGBERT

The qualitative nature of the U.S. national farm price and income dilemma has long been generally but rather vaguely known. Contemporary econometric analysis can identify more precisely the magnitudes and interrelations that compose and surround this perplexing dilemma. This article undertakes to go beyond the established approach of measuring supply and demand price elasticities to the equally important and perhaps more productive identification and measurement of the relevant supply and demand shifters. By projecting magnitudes to 1985, long-run policy implications of prospective changes can be examined with greater acuity.

THE farm price and income dilemma has been around a long time. Except for unusual periods such as wartime, agricultural output tends to race ahead of commercial market outlets. As a result, without special programs, prices of farm products deteriorate over time relative to prices in other sectors of the economy. And farmers' low position on the income ladder does not improve much in spite of and, to a degree, because of great advances in productivity. The nature of this income dilemma, in a qualitative sense, is well known and has been well documented. Its quantitative nature is still quite vague. The disagreements concerning the production-consumption gap in agriculture and the magnitudes of supply and demand price elasticities for agricultural products are evidence of this vagueness.

The primary objective of this paper is to throw some additional empirical light on the price and income problem through the use of contemporary econometric techniques. In the first part, we present a simple step-by-step development of the methodology. Next we show that supply and demand price elasticities are only part of the explanation of the farm income dilemma. This conclusion is not new. See, for example, Cochrane [1]. Others, too, have been aware of the total problem [3], [4], [5], [6]. Yet, much of the empirical work has focused on measurement of supply and demand price elasticities. An equally important and perhaps more productive activity may be the identification and measurement of the relevant supply and demand shifters. In this article, we attempt to do both.

In the final section, some of the longer-run policy implications that result from the analysis are presented, assuming, of course, that the model has a large degree of validity.

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The long-run implications depend on relative rates of change in total supply and total demand for agricultural products, including stocks, imports, and exports. These changes in turn rest on technological developments, general economic expansion, population growth, changes in factor and product prices, agricultural policy, and so forth. In order to look at policy implications, projections to 1985 are made, based on assumed changes and trends in major factors that affect growth or decay in the domestic supply and demand for agricultural products. The effects of alternative growths in exports also are evaluated.

Conceptualizing the Supply and Demand Structure of Agriculture

The general model:

$$Ay_t + B_1y_{t-1} + \cdots + B_iy_{t-i} + \cdots + B_ny_{t+n} + Cz_t = e_t \qquad (1)$$

Definitions:

A = a matrix of coefficients related to current endogenous variables
B_i = a matrix of coefficients related to endogenous variables lagged i periods
C = a matrix of coefficients related to current exogenous variables
y_t = a vector of current endogenous variables
y_{t-i} = a vector of endogenous variables lagged i periods
z_i = a vector of current exogenous variables
e_i = a vector of errors

The model as specified by (1) is quite general and can include any number of products with *supply* and *demand equations* for each, identities for market clearing conditions, definitional equations, and so forth. This system implies that the endogenous variables are either recursively or simultaneously related, or both.

The model (1) allows for a very large but finite number of commodities. However, to keep the analysis relatively simple so that the policy implications are clear, all agricultural commodities are aggregated to one product in this application of the model. Feed and seed are netted out of this aggregate because they are consumed within the agricultural sector.

A priori structure

Domestic Supply.—From a pure theory viewpoint, supply of a product is expected to be functionally related to the price of the product, prices of variable inputs, the level of fixed factors available for production, and the level of technology. Consequently, *a priori*, the supply function was assumed to take this general form:

$$QP_t = f(P_t, \cdots, P_{t-i}, \cdots, P_{t-n}; \cdots, PP_{t-i}, \cdots, PP_{t-n}; WI_t, L_t, T_t) \qquad (2)$$

where

QP_t = total domestic agricultural output except feed and seeds (value aggregate, 1957–59 farm prices), in year t

P_{t-i} = index of prices (1910–14 = 100) received by farmers for all products except feeds, lagged i periods

PP_{t-i} = index of prices paid (1910–14 = 100) by farmers for items used in production, lagged i periods

WI_t = index of weather

L_t = total cropland used for crops

T_t = time, a proxy for technological change, 1949 = 49

WI_t, PP_{t-i}, L_t and T are assumed to be exogenous or predetermined.

Domestic demand for consumption.— Similarly, *a priori* domestic demand was assumed to be functionally related to price at the farm; the marketing margin, prices of all nonfood commodities, total disposable income, and other non-identified variables related to time. Symbolically, the general demand specification is:

$$QC_t = f(P_t, \cdots, P_{t-i}, \cdots, P_{t-n}; FR_t, \cdots, FR_{t-i}, \cdots, FR_{t-n}; NF_t, I_t, T_t) \quad (3)$$

where

QC_t = total domestic consumption of agricultural products (value aggregate, 1957–59 farm prices) in year t

P_{t-i} = same as above

FR_{t-i} = index of farm retail price spread (1957–59 = 100), lagged i periods

NF_t = consumer price index for all products except food

I_t = total U. S. disposable income

T_t = time, a proxy for changing tastes and other factors affecting consumption that are related to time but are not specified

FR_{t-i}, NF_t, I_t and T_t are assumed to be exogenous or predetermined.

Domestic demand for stocks.—In addition to domestic demand for consumption, there is also domestic demand for stocks. In a pure market economy, the demand for carryover stocks is expected to be a function of stocks at the beginning of the period, current market prices, expected prices, and perhaps a general shift variable such as the level of consumption. However, the major part of agricultural stocks are commodities under price support programs. Hence, stocks are usually accumulated when current market prices are below support prices and reduced when market prices are above support levels. For these reasons, the *a priori* stock demand function was specified as:

$$ES_t = f(P_t, PS_t, ES_{t-1}, QC_t) \quad (4)$$

where

P_t = the same as above

PS_t = an index of support prices for all price supported commodities
ES_t = ending or carryover stocks (value aggregate, 1957–59 farm prices)
QC_t = same as above

Trade.—Imports and exports are the two other quantities that have a significant effect on production, consumption, and prices in the agricultural sector. In fact, these variables complete the supply-demand balance identity which follows:

$$ES_{t-1} + QP_t + IM_t = QC_t + EX + ES_t \tag{5}$$

where

IM_t = imports in year t
EX = exports
ES_{t-1}, QP_t, QC_t and ES = the same as above

Imports represent an additional source of agricultural supply, and exports represent another component of the demand for agricultural products. Conceptually, *a priori* functions could be specified for these variables. However, due to lack of data on foreign prices and markets, these two quantities were assumed to be exogenous, i.e., determined independent of the domestic market.

Only post World War II data, 1947 through 1966, were used in the analysis. These data are given in the appendix, together with an explanation of their sources and derivation.

Methodology and Interpretation of the Empirical Model

Structural equations

Because the model involves variables whose values in any one year are simultaneously determined, the three-stage least-squares technique was used to estimate the structural parameters. For purposes of comparison, the parameters for the structural equations were also estimated by the ordinary least-squares method.

As is usually the case in empirical analysis, some of the above *a priori* specifications were abandoned; some variables were dropped and others added.

Generally, variables were dropped from the equations if coefficients were not statistically significant. All variables, except price in the supply and consumption demand equations, are significantly different from zero at the 5 percent probability level or less. Price was retained in the supply and consumption demand equations, even though the t ratios are less than those of the 5 percent probability level, because (1) the signs are theoretically correct and (2) price is needed to retain a semblance of an economic structure.

While the estimated price coefficients lack precision, derived elasticities are small even when two or three standard errors are added or subtracted; thus, they are consistent with other empirical estimates.

Other variables were added to the equations mainly after analyzing the predictability of the reduced-form equations. For example, analysis showed that there were large differences between actual and predicted stocks when the weather index was above and below average. Further reflection on this fact led to the conclusion that weather should be included in the stock equation. In the data framework used, stocks are measured at the end of the calendar year. Thus, if a huge crop is harvested in the fall, stocks are not likely to be down to a normal level by the end of the year even though prices are very low. In other words, a large crop flows through the distribution channels throughout the year at a more or less normal seasonal pattern.

The final form of the structural model is presented in Table 1. Variables in the final equations not yet identified are:

IP = income per capita

POP = population, total

The negative coefficient for nonfood prices may be explained by the large expenditures by consumers for nonfoods relative to food products. This follows the theoretical case in which the income effect of a change in the price of a product is greater than the substitution effect.

The "best" empirical model turned out to be one that was simultaneous in terms of price, i.e., there are no lagged responses to price in the structural equations as shown in the *a priori* specifications. Theoretically, we would expect some lags in adjustments to price changes. However, sector lags apparently "wash out" in the aggregates. But the same general conclusions with respect to long-run changes would result if measured adjustments were not instantaneous, but made with some lag, as lesser aggregate analyses for livestock have shown (see [2]). Time aggregation, too, can obscure lags in adjustments. For some crop and livestock products—poultry, eggs and vegetables, for example—the lag between price changes and output changes is probably less than a year.

In most cases, the parameters estimated by the three-stage and ordinary least-squares have the same relative magnitudes and the same signs. The reason for this similarity needs further exploration. All signs are consistent with conventional theory. The estimated coefficients of the supply equations differ most. As expected, the R^2's of the ordinary least-squares equations are equal to or greater than those for the three-stage estimates. Of course, the R^2's for both sets are based on the assumption that prices are known or exogenous, which indeed they are not. Thus, in the context of the specified model R^2's for the structural equations are irrelevant.

Elasticities were derived from the slope coefficients, using averages for

Table 1. Estimated structural equations

QP	QC	P	$ES =$	K	ES_{-1}	T	L	PP	WI	NF	IP	POP	PS	IM	EX	R^2
						Estimated by 3 stage least-squares[a]										
1	0	−.0319 (.0186) [−.236]	0 =	−58.2000 (17.9300)	0	1.0150 (.1695) [b][3.139]	.0878 (.0283) [.906]	−1.000 (.0297) [−.856]	.1483 (.0367) [.451]	0	0	0	0	0	0[c]	.975
0	1	.0076 (.0051) [.062]	0 =	9.1490 (3.8770)		0	0	0	0	−.1884 (.0473) [.663]	.0034 (.0012) [.263]	.1903 (.0417) [1.145]	0	0	0[c]	.987
0	0	.0367 (.0082) [.443]	1 =	−15.1600 (3.9790)	.4977 (.1478) .513	.2359 (.0749) [1.098]	0	0	.1634 (.0272) [.748]	0 0	0	0	.0470 (.0127) [.184]	0	0[c]	.987
−1	1	0	1 =	0	1	0	0	0	0	0	0	0		0	−1	—
						Estimated by ordinary least-squares[a]										
1	0	−.0142 (.0162)	0 =	−36.4154	0	.8351 (.1579)	.0519 (.0282)	−.0740 (.0307)	.1397 (.0408)	0	0	0	0	0	0	.978
1	1	.0065 (.0046)	0 =	8.8555	0	0	0	0	0	−.2236 (.0446)	.0040 (.0011)	.2039 (.0391)	0	0	0	.990
0	0	.0377 (.0077)	1 =	10.1122	.5754 (.1462)	.1978 (.0755)	0	0	.1597 (.0269)	0	0	0	.0466 (.0126)	0	0	.994
−1	1	0	1 = 0		1	0	0	0	0	0	0	0	0	1	−1	—

[a] Numbers in parentheses are standard errors of the coefficients and number in brackets are the partial elasticities computed at mean of the values for 1964–66.

[b] Annual percentage change computed at mean of endogenous variable, i.e.,

$$\frac{\frac{\gamma y_i}{\gamma T}}{y_i} \times 100.$$

[c] Derived from the residuals.

1964–66 (Table 1). Price elasticities for both supply (.27) and consumption demand (.06) appear to be in line with current thinking; both are very inelastic.

Reduced-form equations

In order to obtain a measure of "predictability" of the structural model, it is necessary to derive reduced-form equations. This derivation involves the following simple matrix equation manipulation:

$$\begin{aligned} Ay_t + By_{t-1} + Cz_t &= 0 \\ Ay_t &= -By_{t-1} - Cz_t \\ Y_t &= A^{-1}(-B)y_{t-1} + A^{-1}(-C)z_t \end{aligned}$$

Thus, the matrix of coefficients of the exogenous variables (C) is premultiplied by the inverse (A^{-1}) of the coefficient matrix of the endogenous variables. Consequently, the coefficients of the reduced-form or the predictive equations are complex functions of the coefficients of both the endogenous and the exogenous variables.

The reduced-form equations derived from the three-stage least-squares structural equations are presented in Table 2. Again, ordinary least-squares estimates of the reduced-form equations are presented for comparison.[1] While the ordinary least-squares estimates of the reduced-form equations are consistent, they are less efficient asymptotically than three-stage least-squares estimates [7, p. 365]. This is true because more restrictions are placed on the estimates via the specifications of the structural equations.

Both estimates of the reduced-form equations are quite similar. However, in several instances the signs are inconsistent with economic logic and theory. The derived structural equations have fewer inconsistent coefficients than the directly estimated equations. This results because the structural equations have the correct signs. However, to be completely consistent, the coefficients also need to be of a certain magnitude. For example, the weather variable appears both in the supply equation and in the stock equation. Because the coefficient for weather in the stock equation is greater than the one in the supply equation, favorable weather increases stocks more than output. Consequently, price increases. This does not appear to be reasonable and is certainly a limitation of the model as it stands. Use of fiscal year data might correct this defect. The inconsistent signs in the directly estimated reduced-form equations result, at least in part, from multicollinearity. However, the estimating precision, R^2, is greater for these directly estimated equations.

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[1] The reduced-form, ordinary least-squares equations were not derived from the ordinary least-squares structural equations, but each equation was fit independently in reduced form.

Table 2. Reduced-form equations

QP	*QC*	*P*	*ES*	=*K*	ES_{-1}	*T*	*L*	*PP*	*WI*	*NF*	*IP*	*POP*	*PS*	*IM*	*EX*	R^2
Indirect estimation—3 stage least-squares[a]																
1	0	0	0	= −36.35706	−.21022 [.144]	.68892 [2.131]	.05103 [.527]	−.05815 [−.498]	.15462 [−.470]	−0.7886 [−.270]	.00142 [.107]	.07964 [.479]	.01966 [.051]	−.41853 [−.052]	.41853 [.072]	0.987[b]
0	1	0	0	= 3.92941	.05242 [.037]	.07793 [.248]	.00878 [.093]	−.01000[c] [−.088]	−.00151 [−.005]	−.16956 [−.597]	.00305 [.235]	.17127 [.059]	−.00472 [−.013]	.10001 [.013]	−.10001 [−.018]	0.986[b]
0	0	1	0	= 684.08700	−6.58409 [−.563]	−10.21235 [−3.941]	−1.15035 [1.366]	1.31079[c] [1.400]	.19793 [.075]	−2.46952 [−1.056]	.04430 [.415]	2.49443 [1.872]	.61555 [.200]	−13.10788 [−.202]	13.10788 [.280]	0.817[b]
0	0	0	1	= −40.28647	.73953 [.763]	.61099 [2.844]	.04225 [.656]	−.04815 [−.620]	.15613 [.714]	.09071 [.467]	−.00163 [−.184]	−.09162 [−.829]	.02438 [.096]	.48145 [.090]	−.48145 [−.214]	0.994[b]
Direct estimation—Ordinary least-squares																
1	0	0	0	= −28.0955	−.19499	2.62837	.04453	−.08020	.22951	−.09802	.00270[c]	−.66179	.04797[c]	.37453	1.12920	0.992
0	1	0	0	= 16.94013	.20570	.05967[c]	−.00042	−.03297	.04842	−.14811	.00689[c]	−.17481[c]	.03297	.59697[c]	.42862	0.994
0	0	1	0	= 691.8000	−2.70700	−25.06000	−.80490	1.49800	−.22610[c]	1.45300	.04550	5.01100[c]	−.72810	−9.36800[c]	−2.55600	0.946
0	0	0	1	= −44.75964	.60437	2.00205	.04480	−.04729	.18095	.05213	−.00409	−.48063z	.01492	.30696	−.30747	0.997

[a] Numbers in brackets are "total" elasticities computed at the mean of the values for 1964–66.
[b] Derived from the residuals.
[c] Theoretically, the sign is wrong.

Note that the coefficients of exogenous variables in the reduced-form equations are usually less than the comparable coefficients in the structural equation. For example, a one-unit increase in the use of land is estimated to increase output by .09 unit in the structural equations, but by only .05 unit in reduced-form equations. This difference is explained by the fact that the coefficient for land in the reduced-form equation is a function of not only the direct effect of the production equation, but also all price coefficients of the other structural equations, namely .0076 and .0367.

Elasticities for the reduced-form equations are also presented in Table 2.[2] As indicated by these elasticities, time, a proxy for technology, plays a significant part in expanding agricultural output over time. This result is no surprise. As indicated in Table 2, with no change in the other variables, output (in terms of 1964–66 levels) increases about 2.1 percent; consumption increases .25 percent; prices fall almost 4 percent; and stocks increase about 3 percent.

Population, as indicated and as is well known, is the most important shifter on the demand side. However, an elasticity of 1.06 is somewhat hard to explain, except possibly by the increasing proportion of young people in the total population. However, given the probable error, it is sufficiently close to unity, the usually assumed value, to be credible. Per capita income is an important demand shifter, too, especially in recent years of high income growth.

The elasticities in Table 2 demonstrate that price elasticities of supply and demand are only one facet of the farm output and income dilemma. Supply and demand shifters and their relative rates of change are extremely important in determining output, price, and income levels in agriculture over time. And, whether the long- and short-run price elasticity of supply or demand is X or Y percent looms large only in explaining short-term price fluctuations.

The relationship between the estimated values and the actual values of the endogenous variables are shown in Figures 1-A, 1-B, 1-C, and 1-D. The estimated values are based on historical values of the exogenous variables and sequentially estimated values of the lagged endogenous variable, ES_{-1}. In other words, the historical estimates were made in a year-to-year sequence. For example, ES_{-1} for 1947 (actual ES for 1946), together with the exogenous variables for 1947, was used to estimate $\widehat{QP}$, $\widehat{QC}$, $\widehat{P}$ and $\widehat{ES}$ for 1947. Then $\widehat{ES}$ for 1947, together with the exogenous variables for 1948, was used to estimate the endogenous variables for 1948, and so forth. As can be seen, the estimates of the endogenous variables "track" the actual values quite well. This was indicated by the R^2's. However, these coefficients are

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[2] Note that these elasticities are "total" elasticities; that is, they reflect the net effect of the exogenous variable on the endogenous variable after price changes are accounted for (see table 1).

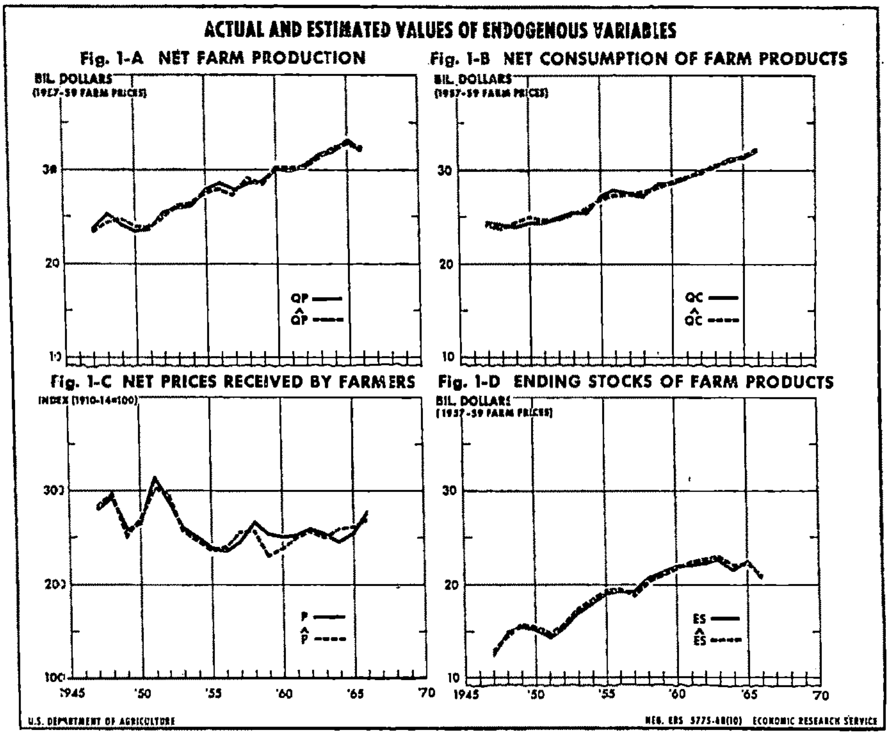
ACTUAL AND ESTIMATED VALUES OF ENDOGENOUS VARIABLES

Fig. 1-A NET FARM PRODUCTION

Fig. 1-B NET CONSUMPTION OF FARM PRODUCTS

Fig. 1-C NET PRICES RECEIVED BY FARMERS

Fig. 1-D ENDING STOCKS OF FARM PRODUCTS

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not very precise indicators of how well the turning points are predicted. Graphics adds this information.

The Future and Policy Implications

In the span of little over a year, the general attitude has swung from "agricultural output must be turned loose or millions around the world will starve" to "lets keep output under control or farm prices will fall to disastrous levels." What is a realistic attitude? Do we still have a production-consumption gap in agriculture?

The model was used to throw some additional light on this question. While such an aggregative model can not give precise irrevocable answers, it hopefully can give rough and ready answers. The remainder of this section describes several conditional projections to 1985, based on simple extrapolations of the exogenous variables and certain policy assumptions.

Alternative I assumes (1) that acreage diversions and price supports remain at the 1968 levels and (2) that other exogenous variables increase at their long-term trend rates over time, as follows:

	Percent per year
Prices paid for items used in production	0.9
Nonfood prices	2.4
Income per capita (current dollars)	4.6
Population	1.3
Imports	2.0
Exports	4.0

The conditional projections of the endogenous variables follow a somewhat unexpected pattern (Figure 2-A).[3] Even though output expansion is bridled by holding available cropland out of production, average prices are

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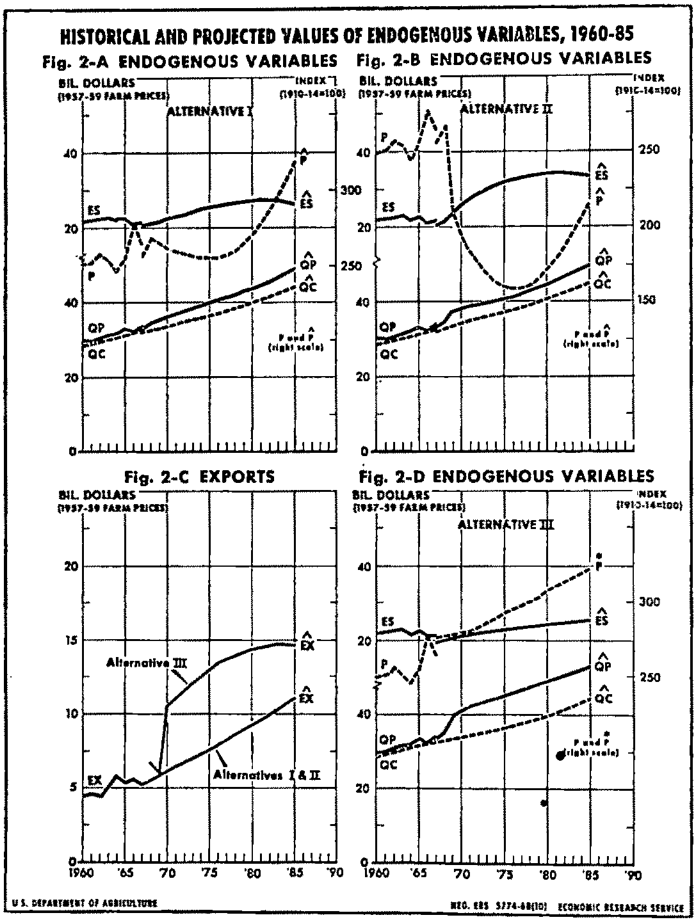
[3] Data for all charts in this set and the supporting exogenous variables are available from the author on request.



HISTORICAL AND PROJECTED VALUES OF ENDOGENOUS VARIABLES, 1960-85

Fig. 2-A ENDOGENOUS VARIABLES

Fig. 2-B ENDOGENOUS VARIABLES

Fig. 2-C EXPORTS

Fig. 2-D ENDOGENOUS VARIABLES

projected to decline moderately through 1974. After that year, demand expansion—domestic and foreign—catches up with output growth. Consequently, prices increase rather sharply up through the final year, 1985. But the estimated average price for 1985 represents only a rate of inflation equal to that assumed for prices paid by farmers. However, the validity of using a model which assumes a linear growth in output and a non-linear growth in domestic and foreign demand is subject to question. Specifically, output due to technology increases linearly over time, but the primary demand shifters—income and population—increase logarithmically.

The implication of the conditional projection is: Even if current programs are continued, additional land will need to be withdrawn from production in order to keep prices of farm commodities advancing at the same pace as other commodities, at least through the mid-seventies. Looking at it another way, this result indicates that surplus productive capacity in agriculture will continue to grow over the next several years.

Even though Alternative I indicates that surplus productive capacity may be increasing for some time, it should be instructive to look at the price consequences in agriculture of eliminating production controls or acreage diversions. This assumption provides Alternative II with the results shown by Figure 2-B. The acreage used in this analysis, 380 million, is an estimate of land that would be used for crops if all diverted cropland were returned to production, with some adjustment for double counting. This acreage, of course, does not represent the maximum amount of cropland that could be used for crops, but only the amount that likely would be brought into production in the absence of land diversion and control programs.

The index of prices received by farmers falls dramatically when diverted land is brought into production in 1969. It continues to fall through 1976, when, again, demand growth catches up with output increase. Despite the dramatic rise that is predicted to occur toward the end of the period, the average price is still below the current index. The wide swing in price that occurs under this alternative is due to the low price elasticities of demand for consumption and for stocks implied by the model. Small imbalances in supply and demand result in large changes in prices—an expected result, to say the least.

A number of alternative policy decisions could be investigated under our conditional projection procedure; alternative price supports or changing Food for Freedom exports, for example. More importantly, we might ask: Under what condition(s) could production restraints be taken off of farm production and reasonable prices be maintained?

Because it is quite obvious that domestic demand is unlikely to expand much further than projected in Alternatives I and II, the only conceivable outlet for "excess" production is exports. This proposition certainly is not new; it led to the development of P.L. 480 programs, although they were probably viewed as short-term measures rather than the continuing programs they have become.

Under Alternative III, exports are, in a sense, endogenous rather than exogenous. This variable is replaced in the exogenous set by the prices received index, which is assumed to increase at the same rate as the prices paid index. With this assumed steady increase in price, production, consumption, and stocks also increase at a steady pace over the projection period (Figure 2-D). Exports, on the other hand, would be required to follow a somewhat irregular pattern (Figure 2-C). But in the immediate years ahead, exports would need to increase dramatically—about 70 percent above the level now expected.

The likelihood of such an increase in commercial exports appears to be small. And unless support can be found for greatly expanded "food for peace" programs, which seems unlikely at the present time, the projected level of exports is unattainable.

Conclusions

The policy implication of the preceding analysis appears to be this: Some form of production controls will continue to be needed in agriculture to maintain farm prices and income, at least for the next decade. This situation will prevail unless technological advances and the amount of resources employed in agriculture can be brought into balance with output requirements. Market prices are not likely to bring about this balance. And, in consideration of the price gyrations that result from small imbalances in the agricultural sector, it is unlikely that public policy will be directed toward this end.

The simple model presented in this paper was designed to answer only gross questions about agriculture—its general structure, the nature and magnitude of the output imbalance. It appears to perform these functions quite well. But, as we move further and further into the future, its validity as a model of the gross structure of agriculture is expected to diminish. The level of aggregation also limits the usefulness of the model and probably reduces its precision. We are working on more elaborate models which include more detail (disaggregation) and a greater proportion of endogenous variables. The ultimate econometric model consists, obviously, of only endogenous, lagged endogenous, and policy variables. Econometric models, even the very sophisticated ones such as those developed by the Wharton school, the Office of Business Economics of the Department of Commerce, and the Social Science Research Council and Brookings Institution joint project are far from the millenium. However, in spite of their present limitations, they do permit a better understanding of the complex economic relationships involved, and even of the forecasting process.

APPENDIX

The Basic Data[4]

In general, all production, consumption, imports, exports and stocks are valued at average 1957–59 prices received by farmers [8].

Net agricultural production (*QP*) is the value weighted total agricultural production minus feed and seed used in the production process.

Net agricultural consumption (*QC*) is the value weighted total consumption of agricultural commodities less the same feed and seed subtracted from total production.

Total year-end stocks (*ES*) is the total value weighted stocks held by farmers, inventories held by marketing agencies and processors, and stocks owned by the Federal Government. Thus, it includes more than stocks on farms.

Exports (*EX*) is the value weighted total exports of agricultural commodities. Processed commodities are converted to farm equivalent before weighting.

Imports (*IM*) is the value weighted total of all competitive (e.g., beef)

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[4] See Table A.

Table A. Basic data, aggregate agricultural model

Year	Net production[1] *QP*	Net domestic ports use[1] *QC*	Im- ports[1] *IM*	Ex- stocks[1] *EX*	Beginning stocks[1] S_{-1}	Ending stocks[1] *S*	Time[2] *T*	Crop-land used for crops *L*
	Bil. dol.	*Bil. dol.*	*Bil. dol.*	*Bil. dol.*	*Bil. dol.*	*Bil. dol.*		*Mil. acres*
1947	23.632	24.425	2.978	2.706	13.011	12.490	47	373
1948	25.059	24.237	3.279	2.104	12.490	14.487	48	378
1949	24.175	24.004	3.205	2.531	14.487	15.332	49	387
1950	23.397	24.480	3.337	2.563	15.332	15.023	50	377
1951	23.707	24.399	3.121	3.122	15.023	14.330	51	381
1952	25.312	24.930	3.269	2.647	14.330	15.334	52	380
1953	26.083	25.633	3.383	2.354	15.334	16.813	53	380
1954	26.202	25.356	2.884	2.596	16.813	17.947	54	380
1955	27.775	27.073	3.272	2.782	17.947	19.139	55	378
1956	28.435	27.904	3.404	3.647	19.139	19.427	56	369
1957	27.877	27.485	3.388	4.070	19.427	19.137	57	358
1958	28.762	27.422	3.500	3.435	19.137	20.542	58	355
1959	28.753	28.570	4.079	3.598	20.542	21.206	59	358
1960	30.127	28.590	3.685	4.492	21.206	21.936	60	355
1961	29.838	29.166	3.868	4.540	21.936	21.936	61	339
1962	30.339	29.818	4.171	4.479	21.936	22.149	62	330
1963	31.646	30.273	4.235	5.012	22.149	22.728	63	336
1964	31.822	31.016	3.851	5.770	22.728	21.615	64	334
1965	31.115	31.285	3.912	5.243	21.615	22.114	65	336
1966	32.058	32.072	4.226	5.605	22.114	20.721	66	332

and noncompetitive (e.g., bananas) agricultural products. Noncompetitive products are mostly valued at the port-side sale price.

For a detailed description of the composition and measurement of all value aggregates, see [8].

The average price (P) is the index of prices received by farmers published by the Statistical Reporting Service adjusted to exclude feed grains and hay. This adjustment was necessary to make the price conform with the products included in the output aggregate. Seed prices are not included in all farm products index.

Cropland (L) used for crops is all land from which crops are harvested plus fallow, idle and abandoned. It does not include cropland pasture.

Prices paid (PP) is the index of prices paid by farmers for all items used in production. It does not include wages, interest and taxes. From a theoret-

Table A. Basic data, aggregate agricultural model—Continued

Year	Prices paid by farmers[3]	Weather index[4]	Prices received[5]	Per capita income[6]	Population[7]	Nonfood prices[8]	Price supports[9]
	PP	*WI*	*P*	*PI*	*POP*	*NF*	*PS*
	1910–14 =*100*	*Index*	*1910–14 =100*	*Dol.*	*Mil.*	*1957–59 = 100*	
1947	224	98.8	280.1	1,179	144.1	75.8	95
1948	250	109.5	293.0	1,290	146.6	81.3	107
1949	238	100.0	259.5	1,264	149.2	82.1	105
1950	246	97.7	265.3	1,364	151.7	83.1	98
1951	273	97.7	312.1	1,469	154.3	88.4	112
1952	274	101.1	290.9	1,518	156.9	90.5	116
1953	256	97.9	260.2	1,583	159.6	92.3	120
1954	255	95.7	249.4	1,585	162.4	92.8	113
1955	251	96.8	238.2	1,666	165.3	93.1	112
1956	250	95.8	235.1	1,743	168.2	94.7	105
1957	257	93.9	244.3	1,801	171.3	97.9	103
1958	264	104.0	264.1	1,831	174.1	100.1	102
1959	266	99.0	252.5	1,905	177.1	102.0	95
1960	265	102.8	250.0	1,937	180.7	103.7	91
1961	266	103.7	251.5	1,983	183.8	104.8	97
1962	270	103.6	257.1	2,064	186.7	106.1	97
1963	273	103.5	253.1	2,136	189.4	107.4	90
1964	270	98.3	245.0	2,281	192.1	108.9	89
1965	276	100.8	255.2	2,426	194.6	110.4	87
1966	285	96.0	277.0	2,584	196.9	113.0	77

[1] Supply and utilization index.

[2] Last two digits of current year.

[3] All items used in production, Statistical Reporting Service.

[4] Index computed as the ratio of actual output per acre to estimated normal output per acre, i.e., $0/\hat{0}$ where $\hat{0}=a+bt+ct^2$.

[5] Statistical Reporting Service, all products less feed.

[6] Department of Commerce.

[7] Bureau of the Census.

[8] Bureau of Labor Statistics.

[9] Support prices of major price supported commodities weight by production.

ical viewpoint, an index that included wage would have been desirable. The index that includes taxes, interest and wage rates was not significant when used in the supply equation.

The weather index (*WI*) is the ratio of the index of crop production per acre to the estimated "normal" production per acre estimated by the equation $0=94.889\ 1.722\,t+.024\,t^2$, where t is the deviation from the mid-year 1953. This equation was fit for the years 1940 through 1966. The quadratic function gave a better fit than the semi-log or compound growth function.

Per capita income (*PI*) is per capita income in current dollars published by the Department of Commerce. The current dollar series was used because nonfood prices function as a deflator in the demand function.

Population (*POP*) is the total U. S. population, 50 States, including armed forces overseas, Bureau of the Census series.

Nonfood prices (*NF*) is the index of retail prices paid for all commodities less food, published by the Bureau of Labor Statistics.

Price supports (*PS*) is an index compiled by weighting the support prices for all supported commodities by their relative annual farm value.

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A Policy for Public Investments in Natural Resources*

Melvin L. Cotner

Both pessimistic and optimistic views exist concerning the effects of resource scarcity on social welfare. Early classical doctrines that assume a fixed state of technology are the theoretical underpinning for the pessimistic view. But a new concept of resources has evolved in recent years that suggests the optimistic view. Resources can be created through science and technology. Existing resources can be made more productive and new resources can be created. Economic growth is a function of adequate resources to absorb investments. Resource creation and the improved use of existing resources, then, are key elements of a policy for public investments in natural resources. From a policy standpoint, public resource improvement investments must be compared with the social benefit streams created. Furthermore, these investments must be compared with alternative investment opportunities, such as extension-education programs, which would improve the use of existing resources.

IN this paper, an attempt is made to recapitulate the classical theory on resource scarcity and broaden it to represent new concepts about resource availabilities. Public policy implications of the broader theory are developed. Finally, principles for public investment strategies for resource development and general technology development are discussed.

Resource Scarcity Doctrines

Both pessimistic and optimistic views can be found among laymen and scientists that natural resources are scarce and are becoming more so. The pessimistic view obviously leads to questions about natural resource limitations on economic growth and the wise use of these resources over time. The optimistic view suggests that resource limitations can be circumvented.

Malthusian scarcity doctrine

During the early part of the 19th Century, Malthus postulated that population increases in geometric progression while means of subsistence increase arithmetically. Thus, in a matter of time, population eventually would begin to press on the means of subsistence. Modern theorists have classified this as the scarcity doctrine. According to this pessimistic view, natural resources, being nonreproducible, have a finite supply; and, as all of the available natural resources are brought into use, the law of variable

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proportions comes into effect. The economy runs into diminishing marginal productivity of labor and capital as these factors expand against the fixed amount of natural resources.

As output per capita declines, the economic welfare of individuals is impaired. Likewise, if economic growth is measured by increase in output, diminishing returns slow the growth rate and ultimately, as output reaches a maximum, economic growth will cease.[1]

Ricardian scarcity doctrine

In its rigorous presentation, the Malthusian scarcity view assumes homogeneous resources and absolute limits on their availability. The scarcity model attributed to David Ricardo relaxes these assumptions by postulating that resources are available, but they have varying economic quality. As demand increases occur, resources of declining economic quality are employed. If, in fact, a society does call in the more productive resources first, then the diminishing productivity associated with increased resource employment would have a dampening effect on economic welfare and economic growth, just as in the Malthusian scarcity model.

Depletion scarcity doctrines

Nonreproducible resources can be depleted or destroyed over time. Stock resources and, to a certain extent, flow resources diminish with use. Soil nutrients, tree growth, minerals, ores, etc., are depletable. Associated with maintaining the renewable or flow resources is the problem of ecological balance. Damage to a single resource or element may deplete the aggregate of the resources available for man's use. The depletion and impairment of the natural balance of the earth's resources allow the Malthusian and Ricardian scarcity doctrines to be more severe. Diminishing returns become more acute and economic welfare and growth more limited.

Faith in Science Doctrine

While at any *given time* the supply of a particular material or group of resources may be limited, there is an optimistic view that over the *long run* the total supply of resources can be expanded. The technology and knowledge springing from science in effect can expand the supply of the resources, either in developing more resources in the same form as the original or by developing substitutes.

The new concept of resources is a dynamic view. As science improves and man's knowledge grows, increasing proportions of our total environment can be used to provide food, shelter, clothing, tools, energy, etc. At the present time, only a small proportion of our total environment is used for these purposes. Likewise, if we accept the view that there is an infinite amount of matter in total space, the horizons are unlimited. Furthermore, if matter is never destroyed by virtue of its being used, and only its current arrangement into useful resources is destroyed, then man needs only to resort to the process of science to develop some new (and perhaps improved) replacement or substitute resources.[2]

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[1] For a discussion of these points, see [6, p. 23].

The implications of this view for economic growth and welfare are profound. There would be no resource limitation on growth. As pressures on resources mount and labor and capital experience diminishing marginal productivity, forces would be set off in the economy to develop substitutes for the resource. Economic welfare need not diminish because of resource scarcity as long as the forces of science and technology can be controlled and directed to this end.

This "confidence in science and technology" could lead resource users to proceed with reckless abandon. However, most individuals who hold the optimistic view also see the necessity of the wise use of existing resources over time. Moreover, technology development and resource improvement requires public and private investments that should be balanced against anticipated benefits. The wasteful use of resources would not be socially desirable. Rather than drift with population trends and technology, this group holds the view that society should strive for increasing control over the key factors in the population-resource problem. This process involves a systematic appraisal of trends in population, resources, and economic activities so that emerging problems may be foreseen and plans made for meeting them.[3]

The Theoretical Dependence of Economic Growth on Natural Resources

The scarcity doctrines can be summarized in geometric form so that the dependent relationships can be seen more clearly. The graphics herein are for explication only and are not meant to imply that broad resource problems have been refined for mathematical analyses. The primary purpose is to develop more explicitly the nexus between the "Malthusian–Ricardian scarcity doctrine" and "faith in science doctrine" and economic growth.

For purposes of clarification of the theoretical exposition, the concepts of economic growth and natural resources are defined.

Economic growth—Economic growth is the added economic activity generated through the utilization of resources to provide goods and services to include not only products and related services but environmental uses as well. For economic growth to occur, capital must be invested to provide new income earnings and, consequently, consumer demand activity. Not only must there be additional resources available for capital and labor investment, but there must be a demand for the goods and services from the resources—making investments attractive. Gross National Product, measured in constant dollars, is the direct measure of economic activity; consequently, the rate of change in real GNP is a measure of economic growth. Economic growth, just as economic efficiency, does not necessarily imply improvements in individual economic welfare and income distribution. Moreover, economic growth may not result in uniform growth among regions and localities. While these are worthy problems, the distributive aspects of growth are not studied in the subsequent analysis.

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[2] For an excellent discussion of the technological advances on the horizon see [3, pp. 127–137].

[3] For a discussion of these views of "cautious optimism," see [4].

Natural resources—Resources are instruments of production that have economic usefulness. Natural resources are such nonreproducible and naturally replenished items as agricultural land, water, minerals, and ores that can be depleted but cannot be reproduced in their exact form, at least with current technology. Natural resources can be manipulated in several ways, anyone of which may be conscious policy objective. Resource use can be regulated so as to conserve, extend, or sustain its use over time. Resources may be depleted and used at exhaustive rates. Resources may be developed to improve their quality and availability over time. Parts of the environment may be combined into entirely new resources for which there is new demand. Accordingly, natural resource use and development is a dynamic process.

The static theory of resource scarcity

Classical theory, as discussed in the previous section, holds that limited resources will have the ultimate effect of restricting output in the economy. The presentation in this section has its roots in the writings of Adam Smith, Thomas Malthus, David Ricardo, John Stuart Mill, and Alfred Marshall.[4]

An aggregate production surface can be conceived where natural resources and nonnatural resources can be combined in varying proportions (Figure 1, chart 1). To be less abstract, one could conceive of an aggregate agricultural production process where units of land would be the resource inputs and the nonresource inputs would be labor and capital combined as a joint input. In a similar manner, the production surface is a composite of agricultural products, say food and fiber production, in this example. Each iso product curve from C_1 to C_6 represents larger amounts or levels of food and fiber production. An expanding population

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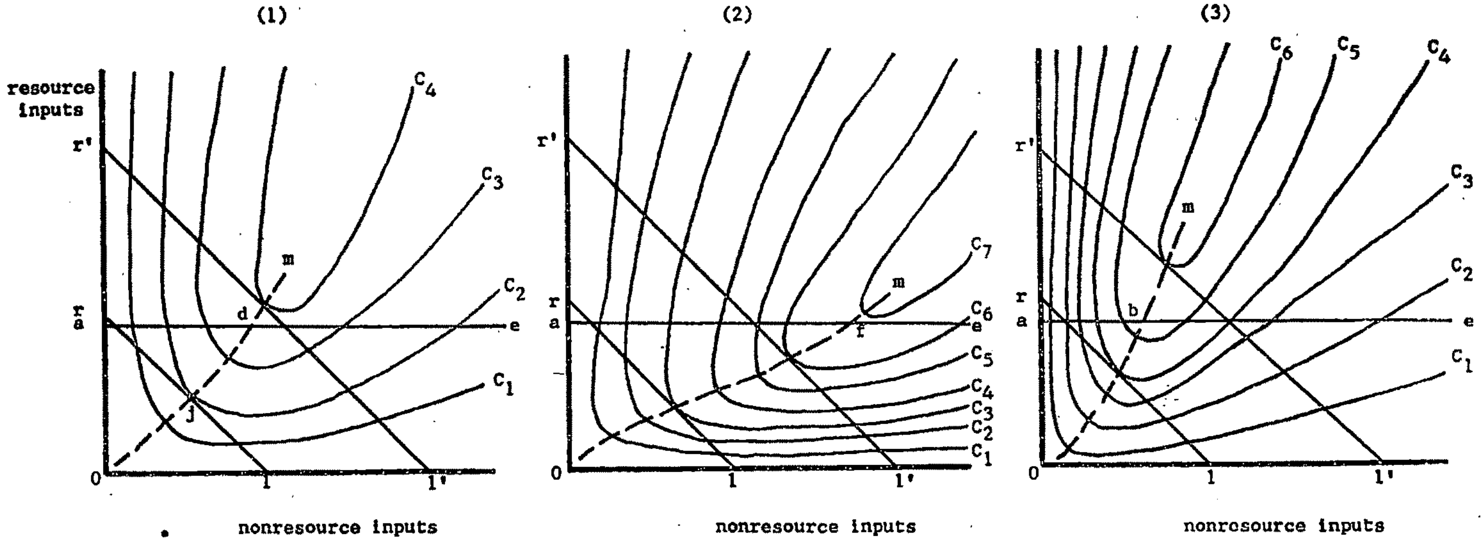
[4] For an excellent summary discussion of the theories of these early economists, see [1, Chapter 3]. The writer is indebted to these authors for ideas in diagramatic presentation



(with resource productivity and technology levels constant)

(with increased technology attainment in nonresource inputs)

(with resource improvement)

Figure 1. Theoretical production relationships from various combinations of resource and nonresource inputs, assuming various levels of technology and resource improvement

in a growing economy presumably would employ resources and nonresource inputs in some combination in some expansion path from C_1 towards C_6. The output in this illustration is measured in monetary terms while the inputs are measured in physical terms. To maintain rigor in the presentation of the concept, the inputs must be of homogeneous quality throughout the range of use and the *ceteris paribus* conditions pertaining to all other variables must hold. A fixed state of the technical arts is an important assumption.

As an expanding society demands more food and fiber, consumers and resource owners should be interested in production patterns that are efficient. Given the production possibilities illustrated in Figure 1, the least costly production pattern and expansion path, *om*, can be derived if prices of inputs are known. A given sum of production capital can be invested to buy all resources, or, alternatively, all nonresource inputs *ol* could be purchased (see chart 1). An iso outlay curve, *rl*, can be derived representing varying proportions of the inputs that can be employed with the given sum or production capital. The C_2 iso product curve is tangent to the *rl* iso outlay curve at point *j* representing the highest product possible for the production capital considered. Alternatively, the production input mix at point *j* is the least costly way of producing the C_2 amount of food and fiber. The expansion path can be traced as increasing amounts of production capital are considered.

With unlimited quantities of resource and nonresource inputs, the expansion path in obtaining increased product is *om*. Resources would not restrict agricultural output. Output, of course, is limited, as the technology attainment assumed has a definite effect in shaping the production functions and their ultimate declining slopes. Output could exceed C_4 (Figure 1, chart 1).

The imposition of a limit on available resources such as *ae* has a distinct limiting effect on output as more nonresource inputs are applied. The expansion path is *od*. Output rises to a point below C_4, then would decline if producers tried to combine more nonresource inputs with the resources. Clearly, the nonresource inputs would be faced with declining productivity. Output in the producer's sector would be limited as a result of resource availability. A case does exist where technology implied in the production functions could become limiting before absolute resource availability would. In this instance, maximum physical product would be reached on the *od* expansion path and would experience a decline before reaching the physical limit of resources.

With resources employed at their limit, two potential economic effects become prominent. As the effective demand for output increases and as attempts to combine more nonresource inputs with limited resources are made, scarcity rents accrue to resource owners. A reciprocal of this effect is reduced payments per unit of nonresource inputs. Resource rents per *unit of output* would increase and nonresource costs per *unit of output* also could increase as larger amounts of nonresource inputs are applied. As a result, the price per unit of output would increase, making the total bill for goods and services from the producers sector higher.

One should note that there would be no economic incentive to push along the path *de*. In this example, some increase in productivity is possible through extended use of nonresource inputs, but declines in total physical productivity soon occur. Atomistic producers face perfectly elastic demand functions, thereby receiving erroneous economic signals to apply more nonresource inputs. If production was kept at *d*, the marginal productivity for nonresource inputs would not experience a decline.

The increase in rent to owners of limited resources implies an increase in asset values. Resource owners have control over a larger share of the wealth in the economy. Nonresource owners' earning capacity remains the same or is lower so they are not as well off relatively nor perhaps on an absolute basis.

In summary, the static theory of production, with all of the attendant assumptions of *ceteris paribus* conditions, does support the view that limited resources would have a negative or dampening effect on economic expansion and growth. Resource owners would gain asset values, while the earning power of other factor inputs would decline relative to that of resources.

Resource scarcity as related to propensities to consume and product demand elasticity

The ultimate effect of resource limitations on economic growth cannot be traced until the income recipients have utilized their income. Since nonresource owners have less disposable income and resource owners have more, there is potential for different propensities to consume that would have an effect on the economic activity generated through the income multipliers. One cannot say categorically that there would be less economic activity with shifts of purchasing power from non-resource owners to resource owners.

If resource limitation involves a product for which there is an elastic demand, the decrease in economic growth may be short-lived. An elastic demand suggests that alternate products could be used readily, thereby relieving the pressure on the product with limited resources. The effect on economic growth may be negligible also if the resource that is limited is small relative to the total of all resources used.

If the resource that is limited produces a product for which there are inelastic demand requirements and the product is a major one in the economy, then the effect on economic activity can be significant. In fact, an unstable situation would exist for major products having an inelastic demand and scarce resource inputs. Increased scarcity rents would provide income that, when spent, would create jobs, which in turn would create added demand for the product of the limited resources. If allowed to persist, the end effect would result in a concentration of wealth in the hands of resource owners. Accordingly, returns to non-resource inputs would be driven to the minimum level sufficient only to bring them into use.

The view that returns to nonresource inputs would reach minimum levels allowed the early classicists to label economics as the "dismal science," to identify "subsistence theories," develop the "iron law of wages" and predict wide scale famines. These are logical conclusions, given the static, changeless conditions believed to exist by these theorists.

Relaxation of the technology assumption

If the state of technical arts is allowed to change, resources may be less limiting in the production process (Figure 1, chart 2). Under conditions of an increase in general technology attainment, the expansion path, *of,* calls for different combinations of resource and nonresource inputs than under the initial technology assumption (compare charts 1 and 2). The physical quantity of the resource remains the same in chart 2. Even so, higher levels of product requirements can be produced before the physical limit is reached. Technology has the effect of increasing the amount of product attainable with a given level of resources. In chart 2, the C_3 level of production is obtainable from the *rl* outlay function. In chart 1, the same outlay produces the C_2 level only. Economic growth is fostered as inputs are released to be employed in other productive measures.

Well known examples of technology advances in agricultural production in recent decades are hybrid corn and other improvements in seed varieties. Widespread availability and use of inorganic fertilizer is another. These measures in conjunction with mass mechanization have had a significant influence on the culture of crop and livestock production. General technology, as conceived in chart 2 comes about through education and other so-called expenditures in human capital. Productive capacity is influenced indirectly through the improved know-how of the human inputs in the production process. Contrary to the views of the early theorists, the state of the arts does change. General technology has substituted for natural resources or, alternatively, has made resources more productive. In fact, technology has increased sufficiently so that abnormally high natural resource rent and product price rises have not come about.

Introduction of resource improvement

Improvements in the natural resources can have an effect similar to that of a general technology increase (Figure 1, chart 3). Any measure that has the effect of improving the productivity of the natural resource also has the capacity of reducing the resource scarcity effect. The expansion path is *ob* with resource improvements. Again, higher levels of product are attained before the absolute limit on resources is reached. In the illustration, resource improvement allows output to be produced with considerably less inputs.

Resource improvement or development is another form of technology. The distinguishing feature of resource development is its physical link with the resource. Public expenditures can be applied directly to influence productive capacities of the resources. Agricultural land drainage is an example. Tile drainage, in a strict sense, may be a technological improvement, but it is considered resource development because of its unique spatial relation to the resource. The agricultural land resource has been improved. Large sums in both the private and public sectors have been spent to clear, drain, and irrigate land. These improvements, when coupled with general technological improvements, have lessened the negative effect of resource scarcity on economic growth.

Dynamics of resource use

Schultz states that economic growth results from a dynamic disequilibrium [7, p. 27]. As demands shift, opportunities to utilize existing resources or develop substitute resources with a high payoff come into existence. As the resources are developed and the particular demand satisfied, rates of return on investment decline, thereby slowing the productive investments and deterring economic growth. To make economic growth a continuous positive function, new or expanding demands and new sets of resources or improved existing resources must be available for productive use. The maintenance of an ample and relevant set of resources in which investments can be made are of primary concern to a society interested in economic growth.

A product requirement of C_4 under the assumptions in Figure 1, chart 1, is unattainable. As attempts are made to achieve this product, economic growth would tend to be dampened as labor and capital productivities decline. The degree that economic growth is sloped depends upon the elasticity of demand for the product from the limiting resource and the size of the product market relative to the whole economy. But this is a disequilibrium that will call for corrective measures, provided, of course, that an adequate institutional framework exists in the public and private sectors of the economy. The higher profits (rents) to the resource provide the incentive for technological inputs to capture some of the abnormal rents. With an increment of general technology as assumed in chart 2, resource earnings would be diverted to nonresource inputs. The new inputs, which really are manifestations of new resources, are applied until the new demand requirement is satisfied. The new inputs also could become scarce, command abnormal rents and entice substitute inputs. Resource managers must be ingenious and be innovators if measures to correct the dynamic disequilibrium forces are to be most effective. In fact, one could generalize the healthy economy as one in which there could be many resource barriers, but knowledgeable entrepreneurs are adopting technology to circumvent the resource problems. Shifts in the productive capacity of resources such as shown in charts 2 and 3 must come about if economic growth and a full employment economy are to be sustained. Presumably, some mix of public expenditures for research, extension education, and resource improvement will facilitate the dynamic adjustment process.

One can conceive of a grand strategy to minimize the effects of resource limitations on economic growth. The theory summarized in this section suggests that as the original supply function of a resource becomes more inelastic, the scarcity returns potential becomes great. Further, the theory indicates that as the demand for the product of a limiting resource becomes more inelastic, the potential effect in limiting growth is greater. The strategy through time, perhaps, would be to concentrate public investments in the area of those conventional resources most likely to inflict diminishing marginal returns on other inputs, thus expanding productive capacity as conceptualized in charts 2 and 3 of Figure 1.

In the public sector, decisions about investments of public funds in general technology development and specific resource development can be subjected to the marginal calculus of economics. In general, the stream of social benefits from public investments in increasing the nation's productive capacity should be equal to or greater than the stream of social benefits in the private purchasing power foregone in the investment.[5] If the marginal increase in productive capacity and resulting stream of social benefits is smaller than the increment of public investment and its opportunity costs if left in the private sector, the expenditure would have a negative impact on economic growth. The above criteria relate only to the magnitude of economic activity and not to the effect on the distribution of personal utility streams. As indicated, wealth distribution is an extremely important problem, but is not analyzed here.

Presumably, there is a functional relationship between investments in research, education, and extension activities and shifts in the productivity capacity of the nation's resources. Likewise, public expenditures in making resources more productive are functionally related. A basic question arises: Can a society expect increasing, constant, or diminishing returns to resource improvement and general technology development expenditures?[6] Within a given state of the art, diminishing returns do occur. But in a dynamic sense, can the state of the art be expanded indefinitely without incurring increasing costs? As a society advances in a more complex and rapidly changing environment, conceivably the limiting resource will be the capacity of the human factor to keep pace by providing new technology. Public decisions can be improved if these functional relationships are known, and meaningful information on public and private costs and benefits are developed.

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[5] The productivity criterion for public expenditures is advanced by James Buchanan [2].

Policy Implications

The principal policy implication to be drawn from the discussion in this paper is that positive actions should be undertaken to insure that resource barriers do not become critical and that losses in economic activity are minimized. To achieve sustained economic growth, adequate institutional arrangements must be provided. Presumably, public investments to assist in the development and adoption of technology in relevant areas are justifiable uses of public funds, given favorable benefit and cost relationships.

But there are questions about the role that public agencies should play in directing the flow of resource creation. Some fiscal theorists argue that government should play a passive role in resource allocation and development schemes. In other words, the public programs should not alter the workings of the market in the private sector in calling forth resources and employment. In this view, the government would undertake only those measures necessary to soften temporary cyclical adjustments in the economy. Other fiscal theorists argue that there is a persistent and chronic gap between full employment and existing employment levels. With the Employment Act of 1946, this group feels that policy and responsibility of the Federal Government becomes one of coordinating and utilizing its functions and resources to achieve maximum employment, production, and purchasing power.[7]

Those who argue for a passive role of government must concede that all public actions, including decisions not to act, have a definite influence on resource allocations. Therefore, the acceptance of either political philosophy should not preclude research and analyses of the potential gains and losses of alternative public actions in the resource area and an analysis of constructive means and priorities for alleviating resource problems.

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[6] Schultz raises this question and suggests that research "may well be in its increasing returns phase." He makes no prognostication on this point except that "returns to these inputs to society are large (and will be) substantially larger than returns from most alternative uses" [8].

[7] For a presentation of the Heller-Burns arguments on these points, see [5].

Policy for research and extension education investments

The public policy for research and extension education should be one whereby resource creation from such expenditures is adequate to achieve the desired growth and employment goals of society. The criterion involves comparisons of the value of the public investment with the value of the employment or economic activity created. As indicated previously, if the research and education investment is not productive of new streams of economic activity, the measure does not contribute to economic growth. Research and education investments should be compared with alternative investments that increase productive capacity, such as direct public expenditures in resource improvements.

The ability to predict the increase in productive capacity associated with public research and extension educational expenditures is difficult. But if knowledgeable policy decisions are to be made about the use of public funds for research and extension education expenditures to develop and encourage the adoption of technology, estimates of these functional relationships are necessary. Research and extension education expenditures in many cases may well be a better use of available public funds in attempts to minimize the negative effects of limited resources on economic growth. Such hypotheses are in need of empirical verification.

Policy for public investments in natural resource improvements

Public policy for resource improvement also should be one whereby the productivity of our stock of resources is adequate to achieve the growth and employment rates desired by society. In a manner similar to that suggested for research and extension education investments, public resource improvement investments must be compared with the social benefit streams created. For instance, certain social benefits are associated with public cost-sharing arrangements with private resource owners to encourage agricultural land drainage. Similar relationships exist for public investments for irrigation, water quality improvement, recreation development, provision of open space, and so forth.

The theory presented in this paper indicates that public resource improvement or development is clearly an alternative and complement to public research expenditures to promote general technology adoption in preventing negative impacts of scarce natural resources. In the final analysis, some combination of expenditure on research and extension education to indirectly influence productive capacity with direct investment on already-known techniques of resource improvements would be ideal. To properly apply these criteria, considerable information is needed on the functional relationships of the alternative uses of the public monies.

Analytical schemes are needed to inventory current and potential resource problems. An analytical procedure is needed whereby resource problems can be placed in perspective and the effects of alternative public resource development and assistance measures can be identified.

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An Analysis of the 1964 Wheat Option

MAX MOSZER

Wheat farmers operate in a quasi free market in which guaranteed price minima are available upon satisfaction of governmental imposed preconditions. A method is developed with which farmers can evaluate the profitability of available alternatives. In general, there must be sufficient land so that the acreage of wheat relative to the allotment exceeds the ratio of the loan rate to the expected free market price. These break even criteria can be used by policy planners to evaluate proposed programs and to determine their efficacy before their implementation. Ideally, programs should be structured so that the most profitable alternative for the farmer is also the one that will achieve the policy goal. An analysis of statewide aggregate data confirms the theoretical conclusion, based on this methodology, that full participation without additional voluntary diversion was the most profitable alternative open to the wheat farmer in 1964.

THE purpose of this paper is to suggest a method of analysis with which to estimate reaction patterns of large groups when inadequate data exist or when the available information is too cumbersome to be used purposefully. This technique will be demonstrated by an analysis of the 1964 Wheat Option. This is, however, a general method; it can be applied fruitfully by legislators and policymakers in any situation to gain perspective and a first, *quantitative* approximation of a proposal's efficacy. Such a tool is of special interest and importance for agriculture, since much of its output is subject to constantly changing legislation in the face of persisting maladjustment.

The scheme utilizes the conventional, static theory of the profit maximizing firm; it makes assumptions and abstractions as they become necessary. Experts in the area may question the particular assumptions and propose less heroic and less fruitful ones. One purpose of this paper, however, is merely to suggest a relevant technique.[1] It must be remembered that its methods are also subject to the basic criterion employed in the analysis: Marginal Revenue = Marginal Cost.

Provisions of the 1964 Wheat Option

The 1964 program was significantly new; it provided for a two price market, as well as mandatory and additional voluntary diversion, and it eliminated quotas and penalties for selling wheat in excess of the harvest of the acreage allotment. It was a voluntary program: there were no penalties—aside from the pecuniary ones of the market—on farmers who did not wish to comply with the program.[2]

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[1] A paper in a similar vein, dealing with white collar crime, is in preparation by the author. It proposes alternate procedures by which the rate of collection of taxes due may be increased.

[2] The legislation that authorized this program resulted from the 1963 defeat of the 1964

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The program enabled each farmer to choose from three options: (1) noncooperation, which permitted unlimited production but afforded no price support of any kind; (2) partial participation, which provided price support for farmers who complied with the acreage allotment; and (3) full participation, which required a minimum diversion of 11.11% of the allotment, permitted additional diversion of up to 20% of the allotment, and provided nonrecourse loans on the harvest, a direct diversion payment, and payments of marketing certificates[3] on the normal yield of the diverted and harvested acreage, respectively.

Achievement of the policy goals of this program depended upon the alternative chosen by the farmer, which in turn depended upon his evaluation of the course that would maximize his profit on wheat, consistent with the restraints of the market, technology and substitutability of his particular class of wheat, and his other crops. His options are summarized in Table 1.

Table 1. 1964 wheat program alternatives

	Non-cooperation	Cooperation	
		Partial participation	Full participation
Acreage limitation	none	allotment	allotment (1.0–.1111)
Loan rate	not available	\$1.30/bushel	\$1.30/bushel
Mandatory diversion	—	none	.1111 allotment
Voluntary diversion	—	—	up to .2 allotment (total allotment if it is no greater than 15 acres.)
Diversion payment	—	—	.2 of the county loan on normal yield of diversion
Marketing certificates	—	—	\$.25+(\$.45 on 45%) on normal production of the net acreage

Source: [10].

The Analytical Method

Noncooperation is the more profitable alternative only if

$$PCY^* - T_p > ALY^* - T_a \tag{1}$$

where

P = the planted acreage,
A = the acreage allotments,
C = the expected cash or free market price of wheat at harvest,

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Marketing Quota Referendum. For a comprehensive, historical view of wheat programs, see [1] and [3]. The latter and [2] present analytical material as well.

[3] These were the mechanism by which the multiple price structure of wheat was implemented.

L = the nonrecourse loan rate,
Y = the normal yield,
Y^* = the expected yield, and
T = the total cost of production, sub a and sub p on the allotted and planted acreage, respectively.

Equation (1) can be restated as a decision making, break even criterion in the form of

$$\frac{P}{A} > \frac{L}{C} + \frac{T_p - T_a}{ACY^*}\,. \tag{2}$$

Noncooperation is more profitable only if the left-hand side is greater than the right-hand side of (2). This occurs when the ratio of planted to allotted acres exceeds the ratio of the loan to the expected cash price plus a term in costs. In terms of decision making, (2) indicates that noncooperation is the more profitable alternative only if the farmer has sufficient crop land available to make the overplanting ratio greater than the right-hand side. Since A, L, P, and the costs are known at the time the decision must be made, it is possible to combine this information with the farmer's estimate of the future market price to arrive at a rational estimate of the more profitable course.

The cost term in (2) can not be very large. It is the reduction in cost[4] resulting from producing on fewer acres divided by a large number. The divisor approximates total revenue—it is (C/L) as large as the revenue of the cooperator and (A/P) as large as the revenue of the noncooperator. It is not unrealistic to assume that the out of pocket costs of the smaller farmer are the same for both acreages. Then the change in costs is equal to zero and the second term in (2) disappears. If the assumption of constant unit cost is made for larger farms, the cost reduction term also disappears.[5] If the average cost of the smaller acreage is less than that of the larger acreage—$b<a$—there will be a negative bias to the criterion. However, its order of magnitude is small and known. Ideally, the analysis ought to find the most *profitable* alternative but, as has been shown, there is no great difference between revenue and profit maximizing criteria. Accordingly, because of the simplicity, the criteria will be expressed in terms of revenue alone.

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[4] It is the marginal cost of $(P-A)$ acres.

[5] Substitute $T_p = a(PCY^*)$ and $T_a = b(ALY^*)$, where a and b represent the average cost respectively of the noncooperator and of the cooperator, in (2) to yield

$$\frac{P}{A} > \frac{L}{C} + \frac{a(PCY^*) - b(ALY^*)}{ACY^*}\,.$$

This reduces to

$$\frac{P}{A} > \frac{L(1-b)}{C(1-a)}$$

and when $a=b$, the criterion is in terms of the price ratio only.

Evaluation of the Alternatives: Revenue Maximization

Let R_n, R_p, and R_f represent the total revenue earned from noncooperation, partial participation, and full participation respectively. Then, from the provisions of the law, as outlined in Table 1, and substituting the 1964 numerical values when convenient,

$$R_n = P \cdot Y^* \cdot C \tag{3}$$

$$R_p = A \cdot Y^* \cdot L \tag{4}$$

$$R_f = .8889\ (A \cdot Y^* \cdot L) + \$.4275(A \cdot Y) + .02222(A \cdot Y \cdot L). \tag{5}$$

The revenue of the noncooperator is greater than that of the partial participator as long as (3) is greater than (4), or as long as $(R_n/R_p) > 1$,

$$\frac{P}{A} > \frac{L}{C}\,. \tag{6}$$

In other words, for noncooperation to be the more profitable action, the overplanting ratio must exceed the loan rate to the expected cash price ratio.[6] This is identical with the 1938 Act.[7] Of course, when the loan rate is less than the cash price, noncooperation is always more profitable. The incentive for staying within the allotment is the availability of the nonrecourse loan and this is meaningful only when it is greater than the free market price.

The comparison of the noncooperator and the full participator yields, as the ratio of their revenues,

$$\frac{R_n}{R_f} = \frac{P \cdot C}{A \cdot L\left(.8889 + \frac{Y}{Y^*}\left(.0222 + \frac{\$.4275}{L}\right)\right)} \tag{7a}$$

or

$$\frac{R_n}{R_f} = \frac{P \cdot C}{A \cdot L\left(.8889 + .351\,\frac{Y}{Y^*}\right)}\,. \tag{7b}$$

For overplanting to yield a greater revenue than full participation, it is necessary that

$$\frac{P}{A} > \frac{L}{C}\,k. \tag{8}$$

This is identical with equation (6) except for the factor k, which stands for the bracketed terms in the denominator of (7b). The previous analysis therefore stands, and when $k>1$, cooperation is more profitable, all other things being equal.

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[6] This abstracts from the consideration of alternative crops. The problems encountered and the break even ratio associated with the lifting of this assumption are discussed in [3, p. 77].

[7] See [3] for the criterion applicable to this law.

The value of k depends on: (1) the legislated loan rate, (2) the legislated diversion payment, (3) the ratio of normal to expected yield, (4) the legislated minimum diversion to qualify for marketing certificates, and (5) the legislated value of the marketing certificates. Increasing the loan rate decreases the value of k,[8] while increasing the diversion payment and the certificate value increases k. Increasing the qualifying diversion percentage changes the value of k by

$$-1+\frac{Y}{Y^*}V_3, \quad \text{where} \quad V_3=\frac{\text{Diversion payment per acre}}{\text{Loan rate}}.$$

Since the yield ratio is usually less than one (see below), increasing the threshhold diversion, *cet. par.*, reduces k and the effectiveness of the program.

The yield ratio is nominally beyond the farmer's control; a decrease in the expected yield will increase the value of k. The 1964 data, $k=.8889+.351(Y/Y^*)$, require the yield ratio to $\geq .3174$ for $k\geq 1$. This occurs as long as $3.15Y\geq Y^*$, i.e., when the expected yield is less than 3.15 times as great as the normal yield. Since normal yield is defined as the average yield of the past ten years, one would expect this ratio to approximate unity; with a positive time trend of yield, the ratio would be somewhat less than one.[9]

Ordinarily, then, $k\geq 1$; this makes the option of full participation more attractive than the conventional allotment scheme without quotas. It is interesting to comment on the implication of the values of k. When a bumper yield is anticipated, the ratio of normal to expected yield becomes very small. For example, if the yield is expected to be five times as great as ordinarily, k will become much less than unity, but it must be >1 to increase the profitability of full participation. Thus, this program is perverse. In bumper crop years, farmers will be encouraged to plant more, while in lean years, co-

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[8] The whole right-hand side of the criterion increases, however, since L enters k with a factor equal to the value of the marketing certificate.

[9] Assuming that the yield increases at compound interest at the rate a, then the average yield over a ten year period will be $(1/10a)Y_0((1+a)^{10}-1)$, where Y_0= the yield of the first year. This is the numerator of the yield ratio. The denominator, the expected yield of the 11th year, is simply $Y_0(1+a)^{10}$ so that the yield ratio is

$$\left[\frac{(1+a)^{10}-1}{10a(1+a)^{10}}\right].$$

As long as the rate of increase is less than 28% per year, the yield ratio will be $>.3174$. For the values of 1964 it is almost impossible for k to be less than 1.

In 1954, the average yield of all wheat classes was 18.1 bushels per harvested acre and for 1963 it was 25.3 bushels. This increase of 7.2 bushels over 10 years is at a compound rate of interest of about $3\frac{1}{2}\%$. Substituting $a=.035$ in the above equation results in a yield ratio of .836 and $k=1.18$ for 1964. Interestingly enough, 103.5% of 25.3, the 1963 yield, is 26.17. This is almost identical to the reported yield of 26.2 bushels per harvested acre in 1964.

certificates were not withdrawn, the yield ratio would have to be as great as five to make the tradeoff profitable.

It is interesting to see whether inclusion of costs in this calculation would alter this conclusion. Add the change in total cost, ΔT, to the total-change-in-revenue equation. The change in profits, then, equals

$$L(.008Y - Y^*) - \Delta T. \tag{9}$$

Additional diversion is profitable if this expression is ≥ 0, where the change in T is negative. This occurs only when

$$\frac{Y}{Y^*} \geq 125\left(1 + \frac{\Delta T}{Y^*L}\right). \tag{10}$$

To avoid the problem of estimating costs[12] for all states, first state costs as some proportion of revenue, Y^*L, and then assume that the marginal cost of the last acre is equal to $c \cdot (Y^*L)$; the revenues cancel out and, since we are dealing with decreasing output, $c \leq 0$.[13] Clearly, when $c = 0$, i.e., when cost savings are zero, this gives the same results as before: the yield ratio must exceed 125 to make additional diversion profitable.

When costs incurred in the production of the last acre are equal to the revenue received, $c = -1$. It will always be profitable to divert this acre. Substituting $-Y^*L$ for ΔT in the original profit definition, it is seen that the increment to profit is $.008Y \cdot L$. Thus, for 1964, when the loan rate was \$1.30, each additional acre diverted would have increased profits by \$.0104 times the normal yield per acre. Assuming a normal yield of 30 bushels per acre, the reward would be on the order of 32 cents per acre of additional diversion.[14]

The addition of costs do not change the previous analysis; it can be concluded, then, that abstracting from cost considerations does no violence to the results. This conclusion, however, may not hold for those farmers who are allowed to divert their total allotment (if it is no more than 15 acres). On these small farms, significant cost reductions might occur when the wheat operation is shut down. It might be implausible to operate two or three acres; the costs of production and/or sales or marketing might be excessive. Furthermore, the opportunity cost of other occupations or endeavors might be greater than the profit from such small acreage.[15]

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[12] See footnote 5 above.

[13] The argument might be made that the normal yield rather than the expected yield should be used for the cost function. Obviously, this complicates the expression. Costs do depend on the amount of wheat harvested which, of course, is a function of future yield. Moreover, Y can be expressed in terms of Y^* and the last term cancels out again.

[14] It will be recalled that if the export certificates were not lost when additional diversion occurred, the factor on the right-hand side would be reduced to 5. The increment to profit, when cost equals revenue, then would be $.2Y \cdot L$ or \$7.80 per acre.

[15] The additional diversion calculation was basically the same for the 1965 program even though the numerical provisions had been changed significantly. Diversion of the first 11.11%

To sum up, since k ordinarily is greater than 1.0, full participation is (1) more attractive than partial participation and (2) will be limited to the mandatory 11.11%—i.e., voluntary diversion will not occur. For 1964, k equalled 1.18 (see footnote 9); substituting this value in equation (8), the required overplanting ratio = 1.54. It can be concluded, then, that unless the farmer had this amount of land available,[16] he would have found full participation without additional voluntary diversion the most lucrative alternative.

Policy Evaluation of the Program

The obvious goal of the 1964 wheat program was to reduce production by means of free choice by all wheat farmers. This production goal was formulated in acres rather than bushels and in terms of the U.S. total rather than individual farms. It is possible to predict, *ex ante*, the efficacy of a given program to achieve the goal by applying the individual farmer's evaluation on a global basis.

Comparing the alternatives of noncooperation and partial participation and assuming that the loan were greater than the cash price, the possibility of the farmer receiving a greater revenue from noncooperation depends upon the availability of land. At the time the program and the $1.30 rate were announced, it was speculated that 1964 wheat might sell for as little as $1 a bushel. Since the allotment was at the statutory minimum of 55 million acres while planting had exceeded 70 million acres several times in the past, it may be concluded that it was possible to overplant by more than 130% of the allotment. Moreover, some farmers might well have discounted the dollar wheat forecast as propaganda to encourage enrollment in the program. Thus the necessary overplanting ratio would be smaller than 1.3; in other words, the amount of overplanting needed to gain the same revenue as

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of the allotment was mandatory for participation, as in 1964. Diversion of the next 10% was not paid for, although the certificates were not reduced either. Further diversion of up to 10% more would be paid at 50% of the loan rate, without loss of certificates. The criterion for comparing total revenue now becomes $(Y/Y^*)>2(1+.1/t)$, where t is the paid diversion as a fraction of the acreage allotment. Thus $0\leq t\leq .1$. Clearly, the 1965 program is more conducive to additional diversion than the previous one. In 1964, additional diversion increased revenue only when the yield ratio exceeded 125. Presently, if the farmer electes to divert the maximum percentage for which he will receive payment, the yield ratio need only exceed 4. Moreover, the program now encourages lump diversion whereas the earlier one did not. The required yield ratio declines at an increasing rate as the diversion percentage of the allotment increases. In 1965, as before, including the cost saving in the calculation requires the yield ratio to exceed $2(1+.1/t)\ (1+\Delta TC/LY^*)$. Making the same assumption on the relationship between cost and revenue, it can be seen that the 1965 program does bring the yield ratio into plausible ranges. The payment for the maximum diversion of 20% at 30 bushels per acre normal yield would now be $18.75 per acre. Clearly the revision made this part of the program more effective.

[16] One must consider total, not just wheat, land. The provision of this program may make alternate crops more or less profitable. However, the Act did not become law until April 11, 1964—far too late to make necessary adjustments. In fact, diversion was defined by the Department of Agriculture as abandonment.

the partial participator would be reduced and the possibility of profitable overplanting enhanced. While the additional cost of planting in excess of the allotment might be greater than the increment to revenue, we cannot draw the conclusion from the provisions of this law that noncooperation is less profitable than partial participation. On the other hand, the possibility exists that overplanting is perhaps the more profitable alternative.

Equation (8) can be used similarly to evaluate the noncooperation-full participation alternative. Substituting the 1964 values, it is found that the acreage required to make noncooperation yield greater revenue is just beyond the border line of feasibility. With the yield ratio of .835 giving rise to a k of 1.18, the right-hand side of the revenue criterion is 1.54 (1.18 times the L/C ratio of 1.3). That is, the planting of the noncooperator had to exceed 154% of the allotment in order to earn the same revenue as the participator. On a national scale, this required a planting of 84.7 million acres instead of the 55 million allotted acres. The largest wheat planting of record occurred in 1949, when 83.9 million acres were seeded. Since that time, about 5 million acres had been placed in the long range Soil Bank and could be considered unavailable even in 1964 [6, pp. 30–61]. When these national totals are applied to the individual farm, it is then not too tenuous to conclude that there was not sufficient acreage available to earn total receipts equivalent to those available to the full participator.

By using the break even criteria developed in the previous section, the policymaker could have estimated the extent of farmer participation and the success of the program. Moreover, the policy purpose of legislation can be implemented by assigning values which would make profitable overplanting impossible. The profit maximizing farmer would find that, even though cooperation is odious to him, he does not have sufficient acreage available to earn as great a revenue as could be gained from participation.

These conclusions, even though based on aggregates, are valid. The policymaker need not know the reaction of each farmer, nor even that of the average farmer;[17] it is sufficient for him to have the total response of all farmers. Clearly, all farmers can not overplant enough to make the program a failure—85 million acres of wheat—even though some farmers might decide to do just that. The global acreage just is not available.

The Effect of Yield on Program Evaluation

Equations (7b) and (10) express the break even ratios in terms of the ratio of normal to expected yield. This section examines whether and how changing yield and yield expectations affect the conclusions derived so far. To do so, it is necessary to differentiate the right-hand side of the revenue criterion with respect to Y^*, the expected yield. It is advantageous to develop the general case in terms of the following symbols, rather than the values which prevailed in 1964:

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[17] That is not to say that he would not *like* to know individual reactions—it is just that he can not get this information.

Let D = the proportion of acreage which must be diverted to qualify,
V_1 = the dollar value of the domestic marketing certificate,
V_2 = the dollar value of the foreign marketing certificate,
V_3 = the percentage that the diversion payment is of the loan rate,
E_1 = the proportion of the allotment eligible for domestic certificates, and
E_2 = the proportion of the allotment that is eligible to receive foreign marketing certificates.

Assume, for the sake of simplicity, $E_1+E_2=1-D$; i.e., that certificates will be issued on all the acreage which remains of the allotment after deducting the qualifying diversion.[18]

The total revenue of the full participator, then, is the sum of

$(1-D)\ AY^*L$—from the production on the net allotted acreage,
$V_3L\ DAY$—the diversion payment,
$V_1E_1\ AY$—domestic marketing certificates,
$V_2E_2\ AY$—foreign marketing certificates, and

$$R_f = AY^*L\left[(1-D)+\frac{Y}{Y^*}\left(E_1\frac{V_1}{L}+E_2\frac{V_2}{L}+DV_3\right)\right]. \tag{11}$$

The revenue comparison between the noncooperator and full participator is, as before,

$$\frac{P}{A} > \frac{L}{C}K' \tag{12}$$

except that K' replaces the k of (8) and now stands for the expression in the brackets of (11).

In order to evaluate the effect of a change in the expected yield, we differentiate—with respect to Y^*—the right-hand side of (12), the break-even criterion:

$$\frac{-\frac{C}{Y^*}\left[L\frac{Y}{Y^*}K\right]-\left[L\frac{Y}{Y^*}K+L(1-D)\right]\frac{dC}{dY^*}}{C^2}, \tag{13}$$

where

$$K = E_1\frac{V_1}{L}+E_2\frac{V_2}{L}+DV_3.$$

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[18] This seems to be consistent with the intent of the legislation and its administration. While the diversion percentage was 11.11, the marketing certificates were to be issued on 90% of the allotment. The 1965 program increased the minimum diversion by 10% while the total issue of certificates was restricted to 80% of the allotment.

When (13) is positive, an increase in Y^*, the expected yield, increases the required overplanting ratio; when it is negative, rising yield expectations reduce the ratio. To evaluate the sign of (13), neglect the always positive denominator and split the numerator into two parts: the terms weighted by dC/dY^*, the indirect effect, and the first term, the direct effect of a change in the expected yield on the break even ratio. The sign of the direct effect is the opposite of dY^* and thus, as discussed above, it always has a perverse effect: overplanting is more profitable in bumper crop years and less profitable in bad years. In order for (13) to have the same sign as the change in expected yield, dC/dY^* must be negative and the indirect effect must be greater, in absolute terms, than the direct effect. For a given demand curve and acreage, i.e., *cer. par.*, prices and yields move in opposite directions. Therefore, it is possible for these two effects to offset each other. The program, then, is perverse, neutral, or salutary if the absolute value of the direct effect is greater than, equal to, or less than the absolute value of the indirect effect. After manipulating the numerator to

$$-\frac{YK}{Y^*}(1+e)-(1-D)e, \quad \text{where} \quad e=\frac{Y^*dC}{dY^*C}, \tag{14}$$

the test condition becomes

$$\frac{YK}{Y^*(1-D)}=-\frac{e}{1+e}\,. \tag{15}$$

The program is salutary, neutral, or perverse, as the right-hand side is greater, equal to, or less than the left-hand side. Clearly, when $dC/dY^* \geq 0$, the elasticity coefficient is positive, the right-hand side is less than or equal to zero, and is also less than the left-hand side of the test condition; the program is perverse. It is a necessary—but not sufficient—condition that $e<0$ for the program to be salutary. If e is greater than the absolute value of minus one, the right-hand side becomes negative, and the program is perverse in this range also. On the other hand, the elasticity must be large enough—in absolute terms—to exceed the value of the left-hand side. When the two sides are equal, on the borderline, the program is neutral.

What is the elasticity which equates these two terms? This depends on the values of Y/Y^*, K, and $(1-D)$. Substituting the 1964 rates for the latter two terms and assuming the yield ratio to be unity, the required elasticity is $-.28$. This means that if a 10% increase in the expected yield creates a 2.8% decrease in price expectations, the program is neutral. A more responsive elasticity, provided it is $<|-1|$, will cause the break-even criterion to assume values which will make overplanting less profitable. Lifting the assumption on the yield ratio, we see that the required elasticity falls as the expected yield increases (relative to the normal yield). This is shown in Figure 1. Values below and to the right of the curve indicate that the program is salutary; those to the left and above mean that it is perverse.

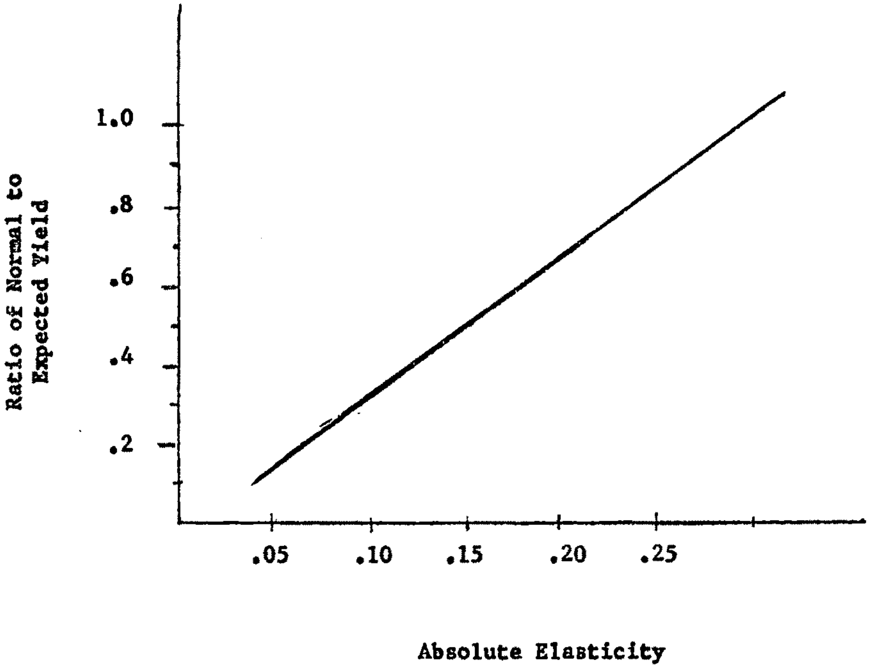

FIGURE 1. Minimum elasticity required for neutrality of 1964 program

While it is not possible to quantify or measure the elasticity of expected prices with respect to expected yields,[19] it seems that the requirement that it be $\leq |.28|$, when the yield ratio is unity, is not so great as to rule it out of the realm of possibility [5].

If it is assumed that a linear relationship exists between C and Y^*, then, as Y^* increases, the yield ratio falls and the required elasticity for neutrality falls, but the actual elasticity rises. This makes the outcome more favorable. The most advantageous assumption for a salutary program is that $d^2C/(dY^*)^2>0$. An increase in the expected yield then causes the elasticity to increase even more. Moreover, this seems to be the most logical assumption. The magnitude of the change in the expected cash price varies directly with the size of the expected yield change (as the yield ratio departs from unity). This relationship is shown in Figure 2.

There is yet another explanation which makes the assumption of the increasing (in absolute terms) slope of the $C-Y^*$ relationship more accept-

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[19] But see Nerlove [4] on this for the necessary assumptions in order to use the technique developed by him to measure responses to expected values of variables.

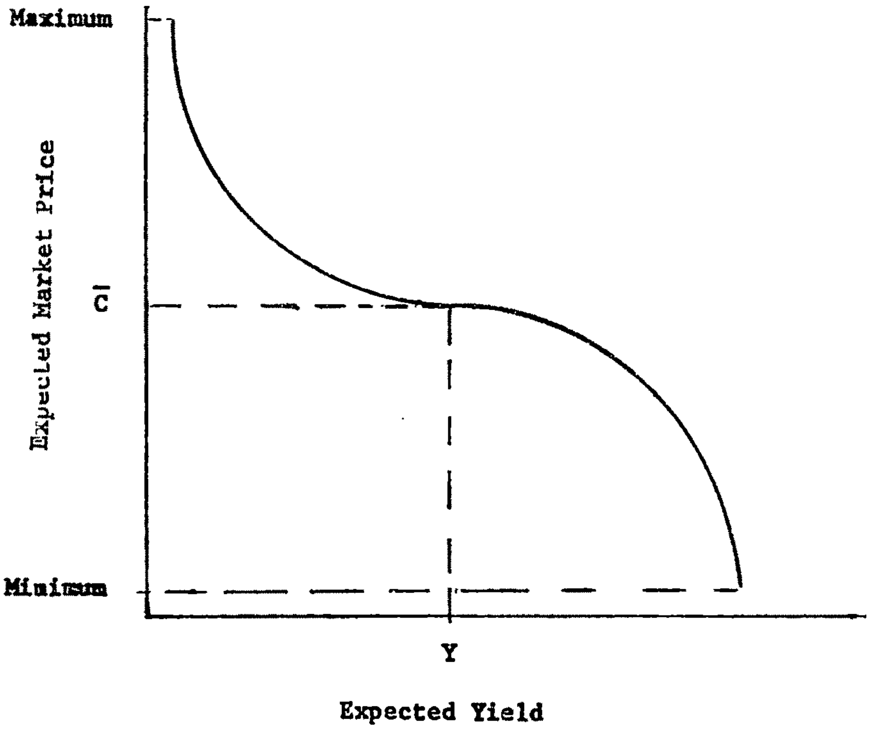

FIGURE 2. **Relationship between expected yield and expected market price**

able. Both of the variables treated here deal with expected values some time in the future. Moreover, while Y^* is the causative variable, the estimate of the expected cash price depends among other things upon the accuracy of the estimate of the expected yield. The farmer has—and probably feels this to be so to a greater degree than is justified—some control over the yield of his crop. Finally one would expect that logic would drive the farmer to the conclusion that he can predict yield better than prices and thus he has more confidence in his yield prediction. The net result of this reasoning is that one would expect the variance of the yield distribution from any given set of weather-technological-miscellaneous conditions to be smaller than the variance of the expected cash price distribution. This means that each expected cash price out of the range of all possible expected cash prices will be held with less certainty than the corresponding yield forecast that has generated it. Accordingly, a large change in the expected yield causes the change in the expected price to be held with more certainty than a small change in Y^* would. In the aggregate then, even if the $C-Y^*$ relationship for each farmer is linear, the result would be the one shown in Figure 2.

It can be shown that even if the $C-Y^*$ relationship is one of decreasing slope, the elasticity may increase over certain ranges as the yield increases, but this is not necessary. As seen in Figure 1, an increase in yield reduces the elasticity required for neutrality. Thus, as long as the actual elasticity falls less than the required (for neutrality) elasticity, the program will still be salutary.

Summing up, then: In view of (1) the low elasticity required for neutrality, even when the yield ratio is as great as unity; (2) the decrease in required elasticity as Y^* increases; and (3) the phenomenon of increasing actual elasticity with increasing expected yield; one can infer that this program is salutary.

The program is not symmetrical, however, when the expected yield falls, first, because this raises the yield ratio and therefore raises the elasticity required for neutrality (see Figure 1), and second, because the elasticity results are the reverse of those applicable to the case of increasing expected yields. For a linear $C-Y^*$ relationship, the experienced elasticity falls with decreasing expected yield. When the slope decreases as the expected yield falls, the experienced elasticity falls even more. The implications, therefore, are ambiguous; the program may or may not be perverse because the elasticity required for neutrality is rising while that actually experienced is falling.

What would result from the assumptions of the previous "most favorable" case? This relationship, in Figure 2, would be the most logical one to support for falling yields as well as for increasing expected yields. Thus, the $C-Y^*$ relationship would have an inflection point as $\bar{C}$, the normal expected price corresponding to Y, the normal yield. As yield falls or rises, price changes in the opposite direction at an increasing rate, until it hits either of two boundaries: (1) the "maximum" price, above which demand for the product falls to zero as substitutes are used to the exclusion of the given product; and (2) the "minimum" price, set by the cost of production.

This turns out to be the most favorable case here as well. While the elasticity for this curve may stay constant or even fall, it can also increase. While there is no *a priori* reasoning that would ensure rising elasticity with decreasing expected yields, the fact is that it could occur here while it is ruled out in the other two curvatures.

We are thus left in an inconclusive position.[20] When yields fall below "normal," the program may be perverse. Farmers may find it profitable to plant less when increased plantings are in order, to keep output constant or in line with consumption. When the expected yield increased, it was thought that profit maximizing considerations would lead to less planting. This was called a salutary effect of the program. Yet we must remember that this program emanates from agricultural surplus. When starting from minimal or normal stocks, it might be perverse for plantings to decrease in lean years; but any decrease in planting can be thought of only as salutary when staggeringly large surpluses exist.

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[20] That is, the program does not permit a more definitive statement at this point.

The 1964 Data

The data of the 1964 program do not contradict the analytical conclusions of the previous section. As shown in Table 2, 35% of all wheat farmers became full participators and received 76% of the United States wheat allotment. The actual diversion amounted to 13.2%, slightly in excess of the 11.11% mandatory or qualifying diversion rate. North Dakota had the lowest diversion rate, 11.46%; South Carolina, the highest, 55.29%.

Table 2. Selected statistics of 1964 wheat diversion program

	U.S. total	Participating in 1964 program	Percent of U.S. total
Wheat farms (number)	1,730,186	611,728	35
Wheat allotment (acres)	53,271,718	40,682,419	76
Diversion			
Qualifying minimum (acres)		4,519,817	11.11
Total diversion (acres)		5,349,376	13.2
"Voluntary" diversion (acres)		829,559	

Source: [7, May 24, 1964].

Table 3 presents some of the details for the 15 largest wheat planting states, all with allotments greater than one million acres. These states accounted for 88.2% of the total national allotment and 91.8% of all the allotted acreage of participating farmers. It is misleading to compare these states' average participation rate of 79.8% with the national rate of 76%, since their share in the total allotment was so large. All the other states enrolled only 3.3552 of their 6.2478 million allotted acres, a participation rate of 53.7%. On the whole, the program was effective: four out of five acres represented participation in the important areas; only one of two elsewhere.[21] The 15 selected states diverted about 13% of their allotment, somewhat more than the minimum 11.11%. The balance of the states averaged 18.6% (.6248 diversion on 3.3552 million allotted acres). This implies that

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[21] If these selected states had been restricted to the largest 9, rather than 15, Idaho would have been the only nonsoft red wheat state excluded. The five predominantly soft red wheat states of Illinois, Indiana, Michigan, Missouri and Ohio enrolled 2.5200 out of 7.2626 million allotted acres. Their participation rate was 34.6%. This raised the 9 other states' rate to 87.5% and lowered the other states' rate to 45.0%. At this time, however, the surplus problem was in hard winter and spring wheat and not in the soft red winter variety. Therefore, the conclusion that this program was effective is not altered.

Table 3. Fifteen largest wheat states—selected statistics of 1964 program allotment

State	Allotment		%	Total diversion (million acres)	% of allot.	Excess or additional diversion (million acres)
	Total (million acres)	On signed farms (million acres)				
Colo.	2.4039	2.1124	88	.3086	15	.0739
Idaho	1.1176	.8939	80	.1116	12	.0125
Ill.	1.7007	.5537	33	.0655	12	.0039
Ind.	1.3097	.3594	27	.0483	13	.0084
Kan.	9.9217	8.9596	90	1.1344	13	.1380
Mich.	1.1296	.3950	35	.0989	25	.0550
Mo.	1.5695	.6657	42	.1103	17	.0364
Mont.	3.6506	3.3113	91	.3909	12	.0229
Neb.	2.9675	2.6098	88	.3143	12	.0243
N.D.	6.8043	6.2042	91	.7111	11	.0221
Ohio	1.5531	.5442	35	.0861	16	.0258
Okla.	4.5946	3.9424	86	.4983	13	.0603
S.D.	2.5788	2.1773	84	.2716	12	.0347
Texas	3.8176	3.0911	81	.3844	12	.0487
Wash.	1.8650	1.6572	89	.1903	11	.0069
Total—15 States	46.9842	37.3272	79.8	4.7246	12.6	.5735
U.S. total	53.2320	40.6824	76	5.3494	13.2	.8425
15 states as % U.S.	88.2	91.8		88.2		67.7

Source: [9, July, 1964, p. 42].

those farmers who found program participation profitable also limited their acreage enrollment to the (neighborhood of the) mandatory minimum. This is consistent with the *a priori* analysis: profit maximizing considerations would lead farmers to divert only the minimum required for participation in the program.[22]

A scatter diagram, showing the acreage allotment per signed farm (state average basis) and the diversion rate, is presented in Figure 3. The diversion rate, the magnitude of which we are trying to explain, is in terms of units, each of which is 11.11% of the allotment. The minimum value this variable can take on is, of course, one. South Carolina has the highest diversion rate, 4.98, which means that these farmers, on the average, diverted almost five times as much acreage as was necessary to qualify for participation.

The fifteen largest states of Table 3 were ranked with respect to both of these variables. Kendall's coefficient of rank correlation is .619. The *t* test yields a value of 3.17. Since this value would occur less than 1 time out of

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[22] That the 5 largest soft red winter wheat states had low participation rates is also consonant with this reasoning. The break-even criterion decreases as the expected cash price increases. With this variety in relative scarce supply, the expected cash price would rise and thus make participation less profitable.

100 if chance alone were operative, the null hypothesis—that there is no relation between size and diversion rates—may be rejected.

The simple regression for the five soft wheat states of Table 3 is

$$\text{Diversion Units} = 3.212 - \underset{(.047)}{.141}\ \frac{A}{SF}, \qquad \bar{r}^2 = .67.$$

This indicates that for every acre that the allotment on a per signed farm basis increases, A/SF, the diversion, decreases by .141 units, or 1.57% of the allotment. Average allotment per signed farm explains two-thirds of the variance of the diversion rate.

Use of a reciprocal transformation on the size variable in the scatter of Figure 3 results in the regression,[23]

$$\text{Diversion Units} = .844 + \underset{(2.017)}{22.976}\ 1/(A/SF), \qquad \bar{r}^2 = .762.$$

In the neighborhood of 120 acres of allotment per signed farm, the slope is −.00102. An increase in the allotment decreases diversion by only .00102 units, or .011% of the allotment. When the size of the average signed farm is 30 acres, however, diversion increases by .0255 units, or .283% of the allotment for every decrease of one acre in the allotment. For 20 acres, the respective changes are .0574 and .683%.

Clearly, variability in size is more important in explaining the diversion rate of small farms than of large farms. Almost one half of the states—20 of the 41 included in the study—averaged more than 30 acres of allotment per signer. Of these, 17 states had diversion rates less than 1½ units, and 13 states, less than 1¼ units; yet participators' acreage allotments ranged from 30 to over 300 acres.

As previously stated, these data are consistent with the analysis. The scatter of Figure 3 and the regression equations indicate that the larger the farm, the closer is the reaction to the theoretical optimum. It may be that small farmers are not as adept at profit maximization as larger farmers. It is possible, however, that the cost reduction on small farms is more significant than on larger farms. Moreover, since farmers with an allotment of less than 15 acres were permitted to divert it in its entirety, the assumption of equation (10), would not hold for these farmers.

Conclusion

It appears that despite the vastly diverse climatological and market conditions surrounding the production of the various wheat classes in the U.S.,

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[23] This is based upon only 41 of the 44 states; Florida, Maine and Massachusetts were excluded because of unavailable data on other variables used in alternate regressions (none of which offered much more than that presented here).

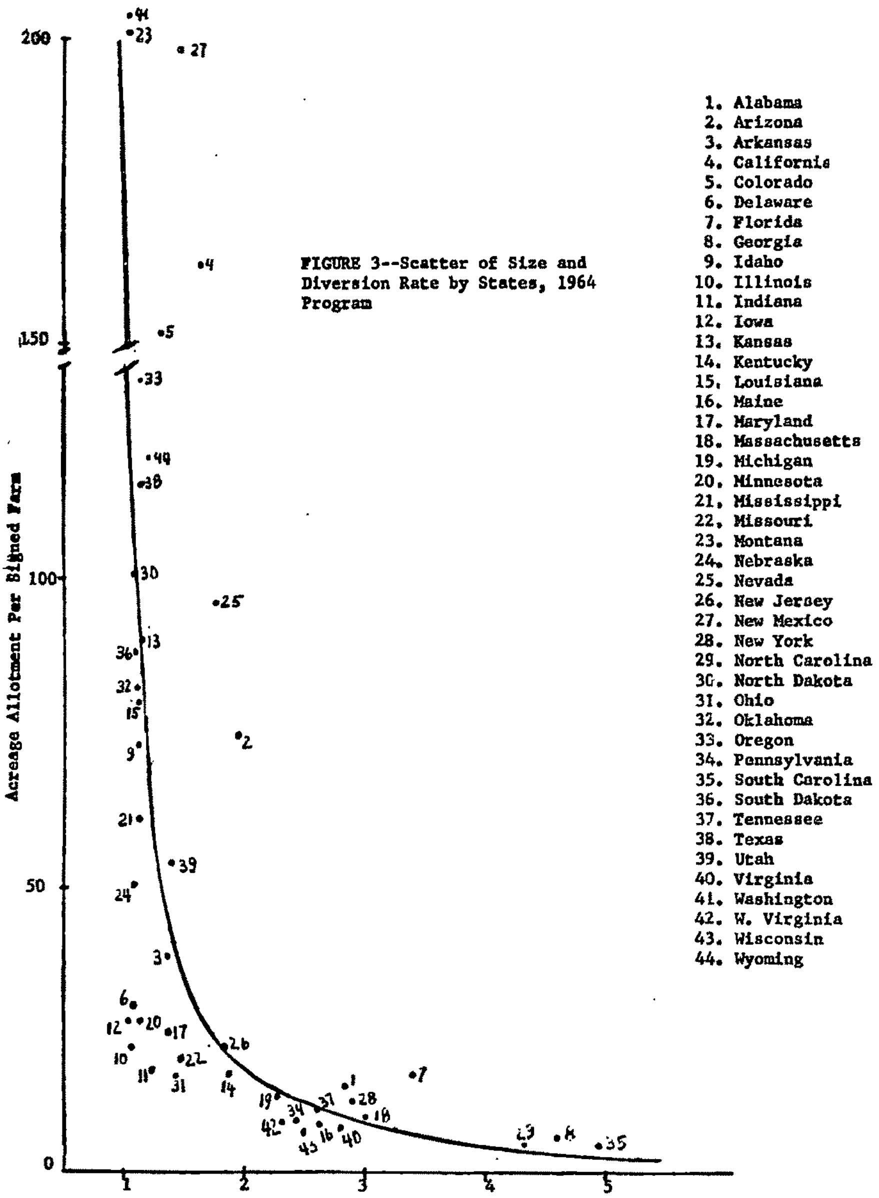

FIGURE 3--Scatter of Size and Diversion Rate by States, 1964 Program

it is possible, through the use of profit maximizing criteria, to approximate the reactions of "wheat farmers" to specific program proposals. In the light of this analysis, it seems that the voluntary program was efficacious in achieving the aims of freedom of choice and acreage reduction. It is clear, however, that additional voluntary diversion should not have been expected.

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Econometric Study of Monthly Consumption Expenditures in Rural Uttar Pradesh*

SURESH D. TENDULKAR

This study presents some evidence of monthly consumption functions in the rural areas of the North Indian State of Uttar Pradesh. Since this region constitutes one of the largest and least monetized in India, attention is specifically focused on the cash and kind (or non-cash) components of (a) expenditure on food articles and (b) total consumption expenditure. Dynamic demand functions of a stock-flow variety are obtained for these broad groups. It is shown that cash outlays act as an inventory-adjustment mechanism whereas non-cash expenditure indicates a habit formation process. This behavioral difference of rural households with respect to cash and non-cash components of consumption expenditure has not yet been demonstrated and is regarded as one of the major results of this paper. With the use of a stock-flow adjustment system, numerical estimates of the instantaneous and steady-state equilibrium elasticities are derived with respect to total expenditure (a proxy for income) and prices.

THE main feature of a rural household economy is the integration of two decision units into one; viz., a family acts both as an entrepreneurial agent cultivating the land with hired and family labor and as a consumer unit determining the pattern of consumption expenditures. The production decision may be assumed to depend on the previous year's harvest and input prices, exogenous variables such as rains and weather, the input-output coefficients, and labor and capital availability. The consumption decision, on the other hand, is governed by behavioral considerations, ruling market prices, and income (in cash or kind) earned from production.

The purpose of this paper is to study a specific phenomenon emerging from the dual role of a rural household: the behavioral decision related to the consumption out of one's own produce or expenditure in kind (also referred to as "non-cash" expenditure) and expenditure in cash. The quantitative importance of this phenomenon in a predominantly rural, semi-monetized, developing economy needs no special emphasis.

The analysis begins with construction of a theoretical model of consumer behavior, with modifications appropriate for the peculiarities of semi-monetized agricultural consumer units, and continues with an exploration of some qualitative implications regarding the effects of prices.[1] Next, a

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[1] A really full-fledged general theory of a rural household economy will have to explain

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brief outline is given of dynamic demand functions of a stock-flow character, and their steady-state properties are analyzed. This is followed by a description of data and variables used and a discussion of empirical findings. In a concluding section, the major results and some limitations of this study are summarized.

Slutsky-Hicks Theory Adapted to Rural Households

Imagine a household with stocks of agricultural commodities, faced with a decision of how much to sell and how much to retain for self-consumption, given the prices ruling in the market. It will maximize the utility function

$$u(q_1, q_2, \cdots, q_n) \tag{1}$$

subject to a budget constraint

$$\sum_{i=1}^{n} p_i(\bar{q}_i - q_i) = 0 \tag{2}$$

where q_i is the amount of the i^{th} commodity consumed, $\bar{q}_i$ is the stock of the i^{th} commodity with which the household enters the market, and p_i is the market price. The cash in hand is assumed to be negligible.

The familiar necessary conditions for equilibrium are:

$$u_i - \Omega p_i = 0 \qquad (i = 1, 2, \cdots, n) \tag{3}$$

where $u_i = \partial u/\partial q_i$ and these n conditions along with (2) determine the $(n+1)$ variables $q_1, q_2, \ldots, q_n$ and Ω, the marginal utility of income. Defining $u_{ij} = \partial^2 u/\partial q_i \partial q_j$, the second order conditions are given by

$$\begin{vmatrix} 0 & u_1 & u_2 \\ u_1 & u_{11} & u_{12} \\ u_2 & u_{21} & u_{22} \end{vmatrix} > 0, \quad \begin{vmatrix} 0 & u_1 & u_2 & u_3 \\ u_1 & u_{11} & u_{12} & u_{13} \\ u_2 & u_{21} & u_{22} & u_{23} \\ u_3 & u_{31} & u_{32} & u_{33} \end{vmatrix} < 0, \cdots,$$

$$(-1)^n \begin{vmatrix} 0 & u_1 & u_2 & \cdots & u_n \\ u_1 & u_{11} & u_{12} & \cdots & u_{1n} \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ u_n & u_{n1} & u_{n2} & \cdots & u_{nn} \end{vmatrix} > 0$$

If we denote the last Hessian by U and the cofactor by a capital letter with the same subscripts as the corresponding element, we get, by differentiating equilibrium conditions (2) and (3) with respect to $\bar{q}_i$,

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simultaneously the interdependent decisions related to the entrepreneurial and organizational factors on the one hand and behavioral responses regarding consumption expenditures on the other, in a general equilibrium framework. Our purpose is not so ambitious, however, both because of theoretical complexities and the lack of time-series data on all the relevant variables.

$$\frac{\partial q_j}{\partial \bar{q}_i} = p_i \cdot \Omega \cdot \frac{U_j}{U} \qquad (i, j = 1, 2, \cdots, n) \tag{4}$$

The partial income effect thus explicitly depends on the price of the commodity whose stocks are varied. The Slutsky equation is given by

$$\frac{\partial q_j}{\partial p_i} = \frac{(\bar{q}_i - q_i)}{p_i} \cdot \frac{\partial q_j}{\partial \bar{q}_i} + x_{ji} \qquad (i, j = 1, 2, \cdots, n) \tag{5}$$

where x_{ji} denotes the substitution term involving rates of change of marginal utilities. Defining the elasticities

$$\begin{aligned} \eta_{ji}^{p} &= \frac{p_i}{q_j} \cdot \frac{\partial q_j}{\partial p_i} = \frac{\partial \log q_j}{\partial \log p_i} \\ \eta_{ji}^{\mu} &= \frac{\bar{q}_i}{q_j} \cdot \frac{\partial q_j}{\partial \bar{q}_i} = \frac{\partial \log q_j}{\partial \log \bar{q}_i} \\ \bar{x}_{ji} &= \frac{p_i}{q_j} x_{ji} \end{aligned} \tag{6}$$

(5) may be written in elasticity terms as

$$\eta_{ji}^{p} = \left[1 - \frac{q_j}{\bar{q}_i} \right] \eta_{ji}^{\mu} + \bar{x}_{ji} \qquad (i, j = 1, 2, \cdots, n) \tag{6a}$$

and

$$\eta_{ii}^{p} = \left[1 - \frac{q_i}{\bar{q}_i} \right] \eta_{ii}^{\mu} + \bar{x}_{ii} \qquad (i, j = 1, 2, \cdots, n) \tag{6b}$$

Note that $\eta_{ii}^{\mu} > 0$ unless a commodity is an inferior good. The sign of the first term on the right depends on $(1 - q_i/\bar{q}_i)$. If for any given $\eta_{ii}^{\mu} > 0$ the household ends up consuming more of the i^{th} commodity than the stock with which it starts, the overall income-effect will be negative, thereby strengthening the gross-substitution effect. On the other hand, if $q_i < \bar{q}_i$, the price elasticity would turn out to be less than the pure substitution effect. The intermediate case $q_i = \bar{q}_i$ results in equality between gross and pure substitution effects. There also arises a possibility of a strong income effect dominating a pure substitution term, thereby yielding a "perverse" gross-own-price-elasticity. The actual occurrence of these possibilities would obviously depend on the levels of initial stocks of different crops and their substitution elasticities in consumption.

Modifications

So far we have been dealing with essentially a classical theory of household behavior analyzed by Hicks [1]. Additional restrictions must be added to the model to take into account some peculiar features of an agricultural economy.

In the first place, if households happen to be below or near subsistence level, the analytical effects of rigidities introduced become uncertain. For example, there may be some minimal requirements of bare necessities to be consumed, whatever the income and price situation. Defining S to be a set of bare subsistence commodities, if for any $i \epsilon S$ the minimal $q_i > \bar{q}_i$, the other commodities q_j where $j \notin S$ may be sold in order to acquire these subsistence quantities, whatever the price situation. In fact, they may be sold in *higher* quantities in situations where (a) the minimal required $q_i > \bar{q}_i$, (b) the prices of commodities $i \epsilon S$ are going up, and (c) the prices of commodities $j \notin S$ are declining. In such cases, we get what are widely described as backward-bending marketed supply curves. The phenomenon is also exhibited for $i \epsilon S$ when the complement of S is empty and cash requirements remain fixed in nature so that when prices received increase, *less* will be sold to the market. The case in which large income effect exceeded the substitution effect, already noted, would create the same situation. These possibilities, however, have to be posed as empirical questions and no *a priori* treatment can be given to them in judging a collective behavior in a given situation.

Secondly, the quantities $\bar{q}_i$ may be understood in a *net* sense, after allowing for seed requirements and non-consumption payments such as rent and debt charges. However, if a farmer is at or below the subsistence level, he may choose to eat the seeds rather than make any non-consumption payments. In addition, $\bar{q}_i$ may also be taken to subsume income received in kind from hired-out labor services and other secondary sources of livelihood.[2]

A final major modification relates to the introduction of prices. The rural retail price indices alone are not sufficient predictors when a basic unit acts as both producer and consumer of the commodities and must decide how much to sell and how much to consume. Under these conditions, the parity index becomes theoretically relevant. The parity index is given by a ratio of the index of wholesle or harvest prices received by farmers to the index of retail prices of non-agricultural commodities paid by them. It indicates the terms of trade of the agriculturists and introduces three effects: (1) an income effect—since prices received by a farmer directly affect his real income level; (2) an own-price-gross-substitution effect in consumption—since prices received by a farmer in most cases refer to those commodities which his household also consumes; and (3) the effect of prices of substitutes and complements upon the composition of the expenditure group under consideration—induced by the component in the denominator, viz., the retail price index of nonagricultural commodities. Both the rural retail price index and the parity index have been introduced into our empirical analysis as alternative explanatory variables. It is therefore appropriate to explore their qualitative implications with reference to some broad expenditure groups considered in our later econometric investigations.

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[2] The author is indebted to J. R. Behrman for these suggestions.

Some Qualitative Deductions Regarding Price Effects

Since food articles account for about three-fourths of the total consumer expenditure in rural areas, we begin by examining the qualitative effects of the retail food prices (p_f) and the parity index (p) upon this group, denoted by q_f, and further subdivided into cash and non-cash components, denoted respectively by q_f^c and q_f^{nc}. Note that q_f^c contains on-farm produced as well as certain off-farm produced commodities, whereas the latter subgroup includes mainly on farm produced goods and perhaps a small part acquired through barter.

With regard to the normal effects of the Retail Food Price Index,

$$\frac{\partial q_f^c}{\partial p_f} < 0; \qquad \frac{\partial q_f^{nc}}{\partial p_f} < 0; \qquad \frac{\partial q_f}{\partial p_f} < 0$$

since p_f catches the usual own-price effect, the important qualification being that the income effects[3] do not overwhelm pure substitution effects. If the last statement does not hold, the signs would be reversed.

As to the effect of the parity index, it may be observed that

$$\frac{\partial q_f}{\partial p} = \frac{1}{\dfrac{\partial p}{\partial q_f}} \tag{7}$$

This is justified because two functions involved are $q_f = \phi(E,p)$ and $p = \psi(E,q_f)$ which may be assumed to be single-valued and the same expenditure level is held constant in both cases. Equation (7) can be expressed further as

$$\frac{\partial q_f}{\partial p} = \frac{1}{\dfrac{\dfrac{1}{p_n}}{\dfrac{\partial q_f}{\partial p_r}} - \dfrac{p_r}{p_n} \cdot \dfrac{\dfrac{1}{p_n}}{\dfrac{\partial q_f}{\partial p_n}}} \tag{8}$$

where p_r is the index of prices received and p_n the index of prices paid by farmers. Is it possible to assess *a priori*, the directions of $\partial q_f/\partial p_r$ and $\partial q_f/\partial p_n$ and hence of $\partial q_f/\partial p$? Taking into consideration the set P of produced and N of non-produced commodities in a consumer basket indicating the areas of applicability of p_r and p_n, several cases may be distinguished, depending upon the composition of the expenditure group:

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[3] Income-effect in this context, as well as in later discussions, is to be interpreted as a composite entity resulting from $\{(1 - q_i/\bar{q}_i)\eta^u_{ii}\}$ in equation 6 (b).

(a) q_f^c belongs entirely or mainly to set P, so that commodities in this group would be substitutes for or are identical with those produced by a farmer. But these are also the goods whose rise in prices leads to increased incomes for him. Consequently, if the income effect of prices received is weaker than the pure substitution effect, $\partial q_f^c/\partial p_r < 0$; otherwise, $\partial q_f^c/\partial p_r > 0$. If the non-agricultural commodities whose prices are changing act as substitutes for those in the group, $\partial q_f^c/\partial p_r > 0$; if complements, $\partial q_f^c/\partial_{p_n} < 0$. The last case appears unlikely when broad groups are considered.

(b) q_f^c belongs entirely or mainly to set N. If commodities in this group are substitutes for those in set P, $\partial q_f^c/\partial p_r > 0$; if complements, $\partial q_f^c/\partial p_r < 0$, the magnitude being determined by the income effect of changes in prices received. $\partial q_f^c/\partial p_n \gtrless 0$ depending on whether income effect does or does not dominate the pure substitution effect.

(c) q_f^{nc} would belong mainly to P, therefore, $\partial q_f^{nc}/\partial p_r \gtrless 0$, depending again upon the relative magnitudes of income and substitution effects; whereas $\partial q_f^{nc}/\partial p_n \gtrless 0$, according as commodities in set N act as substitutes for or complements to those in the group.

The prospect of determining *a priori*, the direction of $\partial q_f/\partial p$ thus appears bleak. If, however, we assume that there is no close relation between p_n and p_r, we can narrow down the possibilities by using the following relationships:

$$\begin{aligned} \frac{\partial q_f}{\partial p_r} &= \frac{\partial q_f}{\partial p}\cdot\frac{\partial p}{\partial p_r} = \frac{\partial q_f}{\partial p}\cdot\frac{1}{p_n} \\ \frac{\partial q_r}{\partial p_n} &= \frac{\partial q_f}{\partial p}\cdot\frac{\partial p}{\partial p_n} = -\frac{\partial q_f}{\partial p}\cdot\frac{p_r}{(p_n)^2} \end{aligned} \tag{9}$$

so that it is clear that $\partial q_f/\partial p_r$ and $\partial q_f/\partial p_n$ will have opposite signs. Hence, although *a priori* it is not possible to find out the direction of change, it may be equally interesting, *once* the direction of the slope, $\partial q_f/\partial p$ is known empirically, to infer about the relative importance of the income and substitution effects as well as substitute-complement relationships between the various groups.

The same considerations apply to the effects of parity price index on the cash and non-cash components (q_c and q_{nc}) of total expenditure, with the additional specific notation that cash expenditures now also include off-farm produced food, non-food, and non-agricultural commodities. Since broad groups are under consideration, the composition of the cash component may conform more closely to that of the price index p_n; therefore, as long as substitution effect dominates (i.e., $\partial q_c/\partial p_n < 0$ and hence, $\partial q_c/\partial p_r > 0$), there is a possibility of getting a positive slope $\partial q_c/\partial p$. The complement of this group may then be expected to have a negative direction with reference to the same parity index.

Analytical Model

The analytical model employed in this paper is the dynamic demand function of the stock-flow variety formulated in continuous time. It was suggested by Houthakker [2] and presented in detail with empirical applications by Houthakker and Taylor [3]. A brief outline is presented here.

Assuming that demand for each good is influenced by one state variable and two flow variables, the following linear relationship is postulated:

$$q(t) = \alpha + \beta s(t) + \gamma x(t) + \lambda p(t) \qquad (10)$$

where $q(t)$ and $x(t)$ are instantaneous flows of consumption and income, respectively; $p(t)$ is price; and $s(t)$ is the level of the state variable at t. α, β, γ, and λ are parameters. The direction of β determines whether $q(t)$ is subject to inventory adjustment ($\beta < 0$) or habit formation ($\beta > 0$).

The generally unobservable state variable can be eliminated by using the relationship:

$$\dot{s}(t) = q(t) - \delta s(t) \qquad (11)$$

were $\dot{s}(t)$ denotes derivative of s with respect to time and δ is a depreciation rate assumed as a constant proportion of the level of the state variable. It has a conventional interpretation in the case of an inventory-adjustment process, whereas, for commodities subject to habit formation, it is taken to measure the speed at which the habit wears off.

By using a finite linear approximation to continuous time, it can be shown that the final estimation equation is:

$$q_t = A_0 + A_1 q_{t-1} + A_2 \Delta x_t + A_3 x_{t-1} + A_4 \Delta p_t + A_5 p_{t-1} + \nu_t \qquad (12)$$

where $A_0, \ldots, A_5$ may be shown to be simple functions of the structural parameters and ν_t is the error term.[4] This is referred to as the Standard Dynamic Model in this paper. The overidentification of δ when both prices and incomes are used as predictors can be handled by an iterative procedure. (For further details, see [3] pp. 8–25.)

In the structural equation (1), γ and λ denote short-term income and price derivatives when state variable is held fixed. However, when stocks are permitted to adjust so that $\dot{s}(t) = 0$, we get from (10) and (11) after rearrangement:

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[4] The structure of this term is investigated in detail in [3], pp. 20–21 and 40–42.

$$\hat{q} = \left[\frac{\alpha\delta}{\delta - \beta}\right] + \left[\frac{\gamma\delta}{\delta - \beta}\right]\hat{x} + \left[\frac{\lambda\delta}{\delta - \beta}\right]\hat{p} \tag{13}$$

where "hats" denote steady-state variables. This gives static limit of the dynamic model with long-run derivatives given by $\gamma' = \gamma(\delta/\delta - \beta)$ and $\lambda' = \lambda(\delta/\delta - \beta)$. Observe that so long as $|\delta| > |\beta|$, with inventory adjustment process ($\beta < 0$), $\gamma' < \gamma$, implying that the initial response to change in income is larger than the long-run effect. On the other hand, in the habit formation case ($\beta > 0$), $\gamma' > \gamma$ because short-run impact is characterized by lethargy and inertia. Similar considerations apply to λ and λ'.

A special case of (12) that occurred in our empirical investigations may here be noted. In certain cases, the statistical difference $|A_2 - A_3|$ and $|A_4 - A_5|$ in equation (12) was found to be insignificant, implying $\delta = 2$, thus eliminating lagged income and prices and leaving current income and prices in the estimation equation. This equation takes the form

$$q_t = B_0 + B_1 q_{t-1} + B_2 x_t + B_3 p_t \tag{14}$$

which has the same form as the Koyck distributed lag equation. However, the interpretation of structural parameters differs from the Koyck formulation and is designated in this paper as the Distributed Lag Variant.

Before closing this section it may be emphasized that from the point of view of our present analysis, the dynamic model has two advantages: (1) it determines operationally whether any given commodity group is subject to an inventory-adjustment or habit-formation process; and (2) it enables us to study both the short-run and steady-state behavior of structural coefficients. It is thus an appropriate theory for bringing out the different impacts of the state variables and the underlying mechanisms of adjustment operating on different groups of expenditure. A somewhat unsatisfactory feature of the model,[5] as used here, is the lack of explicit grounding in utility function. However, the qualitative conclusions reached earlier would nevertheless be verified, since all of them involve observable phenomena in comparative static equilibrium situations. What we deduce from the dynamic demand functions presented in this section are the characteristics of two equilibrium situations: (1) an instantaneous equilibrium with the state variable held fixed and (2) a steady-state equilibrium when stocks are permitted to adjust. Consequently, in both cases, the stock-flow model may be expected to provide an empirical confirmation of the theoretical deductions previously formulated regarding the direction and implications of the price and income effects.

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[5] This drawback has been removed from this theory by introducing a quadratic utility function involving state and flow variables. Preliminary findings are reported by Houthakker and Taylor [4].

The Data and Variables

The data used in this study have been drawn from a time-series of a changing and aggregated cross-section of over 1200 households surveyed monthly in the North Indian State of Uttar Pradesh.[6]

At a monthly level, the concept of a disposable income becomes nebulous and non-operational, especially in seasonal, semi-monetized, and self-employed occupations such as agriculture and related activities in rural areas. Consequently, total expenditure has been used as a surrogate for disposable income, since it is readily observed and more stable in the rural economy. Three price-series (all with the base 1957–58 = 100) have been used in the computations:

(1) The Rural Retail Price Index of food articles (p_f), which forms a part of the Rural Consumer Price Index;
(2) The parity index (p), representing the ratio of the agricultural wholesale prices received by farmers (p_r) to the Rural Retail Price Index of non-agricultural commodities (p_n) bought by them; and
(3) The Rural Wholesale Price Index of agricultural commodities (p_r).

The Rural Wholesale Price Index was used to deflate the total expenditure, its cash and non-cash components, and the Rural Retail Price Index of food articles which in its undeflated form was employed to reduce the expenditure on food articles, both cash and non-cash, to a constant price level.

Choice of Expenditure Groups

The empirical analysis has been carried out for the following broad groups of expenditures per household:

(i) Cash Expenditure on Food Articles (27%)
(ii) Non-cash (imputed) Expenditure on Food Articles (49%)
(iii) Total (Cash plus Non-cash) Expenditure on Food Articles (76%)
(iv) Cash Component of Total Expenditure (46%)
(v) Non-cash (imputed) Component of Total Expenditure (54%).

The figures in brackets indicate the percentage weight of the corresponding groups in the average total consumer expenditure over the six-year period, July 1957 to June 1963, covered by this study. Choice of broad groupings is governed by a practical consideration—that a stable consumption function at a monthly level is likely to exist for those groups of commodities that (a) are consumed frequently within a unit of time interval chosen and (b) form sizeable proportions of total outlays. It may be noted that our concern with cash and non-cash components (especially with reference to total expenditure) violates the generally accepted aggregation criterion of a within group homogeneity, based either on physical similarity of goods or similarity in satisfying a set of related wants. But it is justified if the consuming units treat cash and non-cash components differently with respect to their behavioral responses. That they in fact do so is one of the major findings of this paper.

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[6] Per household value of consumption is published monthly for broad groups of expenditures on a regional basis and detailed for separate classes, such as cultivators, agricultural laborers, and others. The basic data have been collected from the various numbers of the *Monthly Bulletin of Statistics*, published by the Directorate of Economics and Statistics, Government of Uttar Pradesh, India. This study was carried out for the total of all classes and for the entire State of Uttar Pradesh. Anyone interested in details regarding sources, scope, and reliability of the data may obtain this information by writing directly to the author.

Seasonal Adjustment

With regard to the seasonal adjustment procedure, it should be noted that the seasonal influence is very important in models with time intervals smaller than a year. Several statistical techniques are available to eliminate seasonality (see, e.g., Kendall and Stuart [5], Chapter 46); but in most of these there is some degree of arbitrariness, while in some several observations may be lost. Recently, Klein, et al. [6], have suggested an introduction of seasonal dummies in a regression equation for seasonally unadjusted series to catch the effect of seasonality. Their procedure assumes that a seasonal factor works only as a shift factor on an intercept and does not affect regression slopes. In principle, seasonal effects on regression coefficient can also be permitted but the procedure becomes computationally complicated and the loss of degrees of freedom is considerable. In this study, eleven monthly dummy variables are used to represent each month (except June). The choice of the month left out does not affect the slopes and hence is immaterial (see Suits [9]).

Cash, Non-Cash and Total Expenditures on Food Articles

Table 1 presents the reduced form estimation equations for the standard dynamic model for cash, non-cash, and total expenditures on food articles (groups (i), (ii), and (iii), listed above) with three sets of predictors: (a) Total Expenditure, (b) Total Expenditure and Retail Food Price Index, (c) Total Expenditure and Parity Index. Statistically, the corrected squared multiple correlation increases as we move in each case from (i) to (ii) to (iii), as well as from (a) to (b) to (c). The Durbin-Watson statistic is either in an approximately doubtful range (for (a) (i), (b) (i) and (c) (i)) or shows no serial correlation, except 1 (c) (iii), where some evidence of negative correlation exists.[7] The equation I (c) (iii) is unsatisfactory statistically and

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[7] As referees of this paper pointed out, it is not clear, in view of the Nerlove-Wallis paper [7], how much faith one should place in a Durban-Watson statistic when lagged endogeneous variables are included as explanatory variables. The problem of determining the existence of autocorrelation in such situations appears insurmountable. See also [3, pp. 40–42] in this connection.

Table 1. Estimation equations for cash, noncash and total expenditure on food articles: standard dynamic model[a]

$$q_t = A_0 + A_1 q_{t-1} + A_2 \Delta x_{t-1} + A_3 x_{t-1} + A_4 \Delta p_t + A_5 p_{t-1} + \text{seasonal dummies}^b$$

Eq^n. no.	Dependent variable	Explanatory variables	A_0	A_1	A_2	A_3	A_4	A_5	$\bar{R}^2$	D.W.
1 (a) (i)	Cash Expenditure	Total expenditure	7.7574 (3.4776)[c]	0.2259 (0.0946)	0.2318 (0.0616)	0.1247 (0.0382)	—	—	0.5629	1.4992
1 (a) (ii)	Non-Cash Expenditure	Total expenditure	−0.5735† (4.2529)	0.4154 (0.1031)	0.2364 (0.0764)	0.2679 (0.0569)	—	—	0.7594	2.1069
1 (a) (iii)	Total Food Expenditure	Total Expenditure	5.6577 (4.3399)	0.6151 (0.1210)	0.4572 (0.0760)	0.2293 (0.0861)	—	—	0.8331	2.2188
1 (b) (i)	Cash Expenditure	Total Expenditure & Retail Food Price Index	23.2525 (8.6068)	0.1919 (0.0921)	0.2529 (0.0647)	0.1633 (0.0399)	−0.2940 (0.1452)	−0.1899 (0.0925)	0.5966	1.6561
1 (b) (ii)	Non-Cash Expenditures	Total Expenditure & Retail Food Price Index	15.0603 (13.5132)	0.3364 (0.1252)	0.3042 (0.0929)	0.3195 (0.0765)	−0.1575† (0.1855)	−0.1654 (0.1397)	0.7579	2.0433
1 (b) (iii)	Total Food Expenditure	Total Expenditure & Retail Food Price Index	42.5382 (13.5590)	0.3402 (0.1496)	0.5970 (0.0794)	0.4422 (0.1147)	−0.5240 (0.1683)	−0.3881 (0.1397)	0.8616	2.0826
1 (c) (i)	Cash Expenditure	Total Expenditure & Parity Index	0.4389† (9.6408)	0.2202 (0.1264)	0.2816 (0.0691)	0.1554 (0.0759)	0.0832† (0.1765)	−0.0459 (0.0423)	0.5676	1.5236
1 (c) (ii)	Non-Cash Expenditures	Total Expenditure & Parity Index	16.9663 (9.5995)	0.3359 (0.1093)	0.1734 (0.0805)	0.2257 (0.0598)	−0.0743† (0.1501)	−0.0967 (0.0433)	0.7766	2.1330
1 (c) (iii)	Total Food Expenditure	Total Expenditure & Parity Index	5.2404† (9.9588)	0.8425 (0.0738)	0.4537 (0.1031)	0.0464† (0.0499)	0.1627 (0.0719)	0.0167† (0.0519)	0.8162	2.5094

[a] The structural coefficients and elasticities of the estimation equations are given in Table 2 identified by the same subscripts for the equation number as in this table.

[b] The coefficients of the seasonal dummies are not included for reasons of brevity. They may be made available on request.

[c] Figures in brackets denote the standard errors of the coefficients.

† Statistically insignificant (so regarded whenever any standard error exceeded the magnitude of the coefficients).

is presented only for the sake of completeness. Most of the important reduced form coefficients turn out to be statistically significant with expected directions. The structural estimates and elasticities of the equations corresponding to Table 1 are given in Table 2.

The conspicuous finding of Table 2 is the basic difference in the behavior of the households with respect to cash and non-cash expenditure on food articles. The cash component exhibits an inventory adjustment process with $\beta<0$, the immediate impact of increased expenditure being larger than the long-run effect when the stocks of these commodities are permitted to adjust. On the other hand, the non-cash imputed component follows a habit-formation process ($\beta>0$), the impact effect being sluggish and consequently smaller than in the steady-state situation. In the aggregate, food expenditure appears to be slightly habit-forming.

This basic difference is also reflected in marginal propensities and corresponding expenditure elasticities. The marginal propensity to spend cash on a food article lies in a reasonable range—between 0.27 and 0.33 in the short-run; between 0.16 and 0.20 in the long-run. The non-cash food expenditure containing the commodities produced as well as consumed by the farmers turns out to be sensitive to the effects of prices introduced and shows a broader range of marginal propensity to spend—between 0.09 and 0.22 in the short-run; between 0.34 and 0.48 in a steady-state.

For households whose cash outlay on food articles forms about 27 percent of the total, the short-run demand for these commodities may be expected to be more elastic than their demand for goods they themselves produce and consume. This is indeed brought out in our findings: the short-run expenditure elasticity estimates for the former range between 1.00 and 1.23; for the latter, between 0.19 and 0.45. In the long-run, the situation is reversed in cases (a) and (b), whereas the two estimates come fairly close to each other in (c). It is in explaining this phenomenon that the dynamic demand theory outlined earlier proves most useful and illuminating. We have observed that the cash and non-cash components of food expenditure are subject to different adjustment mechanisms which, acting in opposite directions, end up reversing the magnitudes of elasticities in a steady-state equilibrium. For cash outlays, the adjustment of stocks lowers the immediate impact effect in the long-run; whereas for non-cash expenditure, overcoming initial inertia raises the long-run effect considerably. In this connection, reference may be made to a similar empirical finding from budget studies by Sinha [8].

The introduction of Rural Retail Price Index of food articles (case (b)) consistently produces a negative-gross-substitution effect, thereby eliminating one of the sources of backward-bending supply curve; viz., the overwhelming income factor dominating the pure substitution term. The short- and long-term pure substitution effects show *a priori* directions. Cash out-

Table 2. Structural coefficients and elasticities for cash, noncash and total expenditure on food articles: standard dynamic model[a]

$$q(t) = \alpha + \beta s(t) + \gamma x(t) + \lambda x(t) + \lambda p(t)$$
$$\dot{s}(t) = q(t) - \delta s(t)$$

Eq^n. No.	Dependent variable	α	β	δ	γ	γ'[b]	λ	λ'	Expend. elast. S.R.[c]	Expend. elast. L.R.[c]	Price elast. S.R.	Price elast. L.R.	S.R. Subst.[d]	L.R. Subst.
2 (a) (i)	Cash expenditure	17.1935	−0.5868	0.7361	0.2764	0.1610	—	—	1.0187	0.5933	—	—	—	—
2 (a) (ii)	Non-cash expenditure	−0.5719	1.7902	2.6162	0.1447	0.4583	—	—	0.2998	0.9497	—	—	—	—
2 (a) (iii)	Total food expenditure	10.2370	0.1911	0.6695	0.4149	0.5807	—	—	0.5503	0.7702	—	—	—	—
2 (b) (i)	Cash expenditure	40.9033	−0.4021	0.9539	0.2873	0.2021	−0.3339	−0.2350	1.0589	0.7449	−1.2703	−0.8940	−0.9811	−0.6906
2 (b) (ii)	Non-cash expenditure	10.1910	1.2185	2.2116	0.2162	0.4814	−0.1119	−0.2492	0.4480	0.9977	−0.2394	−0.5331	−0.0218	−0.3155
2 (b) (iii)	Total food expenditure	56.9630	0.1918	1.1763	0.5609	0.6702	−0.4924	−0.5883	0.7440	0.8889	−0.6741	−0.8054	−0.1095	−0.1308
2 (c) (i)	Cash expenditure	0.9443	−0.5163	0.7618	0.3343	0.1993	0.0928	0.0589	1.2321	0.7344	0.3682	0.2194	0.7025	0.4187
2 (c) (ii)	Non-cash expenditure	6.8159	2.7324	3.7267	0.0907	0.3399	−0.0389	−0.1457	0.1879	0.7043	−0.0814	−0.3052	0.0099	0.0369
2 (c) (iii)	Total food expenditure	52.7767	−0.0631	0.1079	0.4673	0.2947	0.1676	0.1057	0.6198	0.3910	0.2247	0.1418	x	x

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[a] The corresponding estimation equations of these relations are given in Table 1, identified by the same subscript for the equation number as in this table.

[b] Primed letters denote long-run steady-state coefficients.

[c] S.R. & L.R. indicate short-run and long-run, respectively.

[d] Substitution effect (denoted by "Subst." in the last two columns) is given by $(\eta_p{}^i + \alpha_i \eta_e{}^i)$ where $\eta_p{}^i$ and $\eta_e{}^i$ are elasticities with respect to price & total expenditure, respectively, evaluated at their respective means, and α_i denotes the proportion of the ith expenditure group in total expenditure.

lays on food show higher price elasticity than non-cash expenditure, in accordance with the expectations.

The parity index (case (c)) introduces the three influences previously noted. For both cash and non-cash purchases of food, the effects of changes in prices turn out to be statistically insignificant in the estimation equations 1(c) (i) and 1(c) (ii), yielding short-run price coefficients of somewhat doubtful value.[8] The long-run effect is positive for cash outlay. Based on equation (8), this implies that $\partial q_f{}^c/\partial p_r > 0$ and $\partial q_f{}^c/\partial p_n < 0$, and case (b) appears plausible. In other words, commodities in the cash outlay group are mainly off-farm produced agricultural goods. For non-cash food expenditures, a negative long-run price effect is exhibited which might have resulted from $\partial q_f{}^{nc}/\partial p_r < 0$ and $\partial q_f{}^{nc}/\partial p_n > 0$, indicating that the pure substitution effect of changes in prices received dominates the income term; commodities in this group act as substitutes for those in the non-agricultural group covered by p_n. There is thus a basic asymmetry in the effect of parity prices upon the two components of food expenditure.

Especially for the non-cash group, the coefficients in the reduced-form equations indicate a possibility that the statistical difference $|A_2 - A_3|$ and $|A_4 - A_5|$ may not be significant, thereby giving rise to a Distributed Lag Variant. The absolute differences and their standard errors in different equations are as follows:

	$\lvert A_2 - A_3 \rvert$	$\lvert A_4 - A_5 \rvert$
Equation 1(a)(ii)	0.0315	—
	(0.1140)	
Equation 1(b)(ii)	0.0153	0.0079
	(0.1503)	(0.2640)
Equation 1(c)(ii)	0.0523	0.0224
	(0.1179)	(0.1456)

Consequently, the value of δ was fixed *a priori* at 2.0, and the Distributed Lag Variant was estimated. The resulting estimation equations and corresponding structural estimates are presented in Tables 3 and 4, respectively. The corrected $\bar{R}^2$ goes up, and Durbin-Watson statistics remain

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[8] Intuitively it seems obvious that if one or more reduced form coefficients are statistically insignificant, so would be estimates of structural coefficients. However, it need not necessarily be so. If a function involving reduced form coefficients is expanded in a Taylor series around a true structural parameter, neglecting second and higher order terms, the resulting expression would contain variances as well as covariances of reduced form estimates. A possibility then clearly arises that a structural coefficient may turn out to be statistically significant even though one or more reduced form estimates are not. Hence the use of a loose phrase in the text "of somewhat doubtful value." I am indebted to L. I. Taylor for pointing this out to me.

Table 3. Estimation equals for non-cash expenditure on food: distributed lag variant[a]

$q_t = B_0 + B_1 q_{t-1} + B_2 x_t + B_3 p_t +$ seasonal dummies

Eqⁿ No.	Dependent variable	Explanatory variables	B_0	B_1	B_2	B_3	$\bar{R}^2$	D.W.
3 (a) (ii)	Non-cash food expenditure	Total expenditure	0.4531 (3.9700)	0.4162 (0.0979)	0.2650 (0.0526)	—	0.7683	2.1890
3 (b) (ii)	Non-cash food expenditure	Total expenditure & retail food price index	22.0840 (12.2290)	0.2959 (0.1154)	0.3408 (0.0656)	−0.2284 (0.1224)	0.7783	2.0700
3 (c) (ii)	Non-cash food expenditure	Total expenditure & parity index	18.1370 (7.7336)	0.3524 (0.0962)	0.2155 (0.0535)	−0.0970 (0.0370)	0.7906	2.2472

[a] The corresponding structural coefficients and elasticities are presented in Table 4. See notes to Table 1.

Table 4. Structural coefficients and elasticities for non-cash food expenditure: distributed lag variant[a]

$$q(t) = \alpha + \beta s(t) + \gamma x(t) + \lambda p(t)$$
$$\dot{s}(t) = q(t) - (2.00)s(t)$$

Eqⁿ No.	Dependent Variable	α	β	γ	γ'	λ	λ'	Expend. S.R.	Elast. L.R.	Price S.R.	Elast. L.R.	S.R. Subst.	L.R. Subst.
4 (a) (ii)	Non-cash food expenditure	0.4199	1.1755	0.1871	0.4541	—	—	0.3877	0.9410	—	—	—	—
4 (b) (ii)	Non-cash food expenditure	17.0414	0.9133	0.2630	0.5838	−0.1762	−0.3912	0.5450	1.2098	−0.3769	−0.8367	−0.1121	−0.2490
4 (c) (ii)	Non-cash food expenditure	13.4110	1.0423	0.1593	0.3328	−0.0717	−0.1498	0.3301	0.6896	−0.1502	−0.3139	−0.0102	0.0229

[a] See notes to Table 2. The values of depreciation parameter δ are a priori fixed at 2.00 and hence do not appear in this table

broadly unchanged. The current price term is significant in both equations 3(b) (ii) and 3 (c) (ii), implying that the dynamic effects in non-cash components operate directly through the lagged dependent variable and only indirectly through lagged prices and expenditure. This contrasts with the cash component where dynamic influences act directly through lagged cash outlays, lagged expenditures and prices, the first differences in total outlay, and price changes. When comparing the long-run expenditure elasticities in equations 2(a) (ii), 2(c) (ii), and 4(c) (ii), note that the addition of parity index lowers the estimate and makes it slightly *lower* than that for cash purchases (contrast equations 2(c) (i) and 4(c) (ii)). It thus appears that the explicit introduction of the forces of income effect, own-price-effect, and effects of prices of related goods, represented by the terms of trade index of agriculturists, yields a net expenditure elasticity lower, as expected, than that of retail food price or cash purchases. The overall pure substitution effect in equation 4(c)(ii) is positive and close to zero, implying that different influences of parity index seem to be mutually offsetting in nature. The fact that pure short- and long-run substitution effects in equation 2(c) (i) also are positive is no contradiction, since the cash plus non-cash food expenditures do not exhaust the total expenditure.

The conventional static linear, log-linear, semi-log, and inverse-semi-log forms of demand functions were also fitted to the data. It was found that in most cases dynamic equations perform better, and in a few cases do at least as well as the static forms, in terms of both corrected $\bar{R}^2$ and Durbin-Watson statistic.

Cash and Non-Cash Components of Total Expenditure

We now examine the behavioral relations connected with the cash and non-cash components of total consumption expenditure for which the parity index has been used as an appropriate overall price variable.

Tables 5 and 6 present the relevant estimation equations and structural coefficients, respectively. The corrected squared multiple correlation coefficient is statistically significant in all the equations. Moreover, in most cases, the reduced form coefficients exceed their standard errors by large multiples. A close scrutiny of the equation 5(e)(v) for non-cash expenditure indicates that $|A_2 - A_3| = 0.0089$ with a standard error of 0.1597 and $|A_4 - A_5| = 0.0087$ with a standard error of 0.2057. This suggested a Distributed Lag Variant whose estimated reduced form relation is denoted by 5(ē)(v) in Table 5.

The cash component, now including non-agricultural, non-food articles, such as clothing, footwear, and fuel and light, exhibits an inventory adjustment behavior, whereas the non-cash portion is habit forming in character. Due to omission of a price variable in the first two equations in Table 6, the mis-specification bias in the expenditure coefficient appears to be down-

Table 5. Estimation equation for cash and non-cash components of total expenditure: standard dynamic model[a]

Eq^n. No.	Dependent variable	Explanatory variable	A_0	A_1	A_2	A_3	A_4	A_5	$\bar{R}^2$	D.W.
5 (d) (iv)	Total cash expenditure	Total expenditure	− 4.7134† (6.3645)	0.3977 (0.1045)	0.3139 (0.0851)	0.6269 (0.1112)	—	—	0.6807	2.4762
5 (d) (v)	Total non-cash expenditure	Total expenditure	2.0305† (6.4146)	0.4276 (0.1050)	0.2753 (0.0716)	0.2978 (0.1115)	—	—	0.6518	2.4202
5 (e) (iv)	Total cash expenditure	Total expenditure & parity price index	−35.8697 (13.5537)	0.2773 (0.1176)	0.7185 (0.1173)	0.5123 (0.1151)	0.2328 (0.1660)	0.1660 (0.0633)	0.7165	2.5311
5 (e) (v)[b]	Total non-cash expenditure	Total expenditure & parity price index	37.2760 (14.4886)	0.2688 (0.1259)	0.2032 (0.1158)	0.1943 (0.0709)	−0.2000† (0.2097)	−0.1913 (0.0633)	0.7016	2.3863

[a] The structural coefficients and elasticities of this equation are presented in Table 6, corresponding to equation number 6 (δ) (v). See notes to Table 1.

[b] The Distributed Lag Variant of 5 (e) (v) is given below and is referred to by equation number 5 (δ) (v) in the text.

$$\underset{(11.9230)}{q_t = 42.7210} + \underset{(0.1022)}{0.2351 q_{t-1}} + \underset{(0.0656)}{0.1946 x_t} - \underset{(0.0562)}{0.2141 p_t} \qquad \bar{R}^2 = 0.7314,\ \text{D.W.} = 2.3986$$

Table 6. Structural coefficients and elasticities for cash and non-cash components of total expenditure[a]

Eq^n No.	Dependent variable	α	β	δ	γ	γ'	λ	λ'	Expend. S.R.	Elast. L.R.	Price S.R.	Elast. L.R.	S.R. Subst.	L.R. Subst.
6 (d) (iv)	Total cash expenditure	− 0.3350	−0.3406	0.5212	0.6724	0.5136	—	—	1.4746	1.1263	—	—	—	—
6 (d) (v)	Total non-cash expenditure	1.2074	1.1171	1.7196	0.2243	0.4810	—	—	0.4123	0.8842	—	—	—	—
6 (e) (iv)	Total cash expenditure	−50.8510	−0.0334	1.1079	0.7262	0.7050	0.2353	0.2284	1.5964	1.5497	0.5230	0.5077	1.4233	1.3817
6 (e) (v)	Total non-cash expenditure	32.9270	0.6798	1.8320	0.1672	0.2657	−0.1645	−0.2616	0.3080	0.4896	−0.3565	−0.4869	−0.1893	−0.2212
6 (δ) (v)[b]	Total non-cash expenditure	34.5891	0.7614	2.0000	0.1576	0.2544	−0.1733	−0.2799	0.2897	0.4676	−0.3226	−0.5210	−0.1650	−0.2666

[a] See notes to Table 2.

[b] Corresponding to the Distributed Lag Variant presented in the notes to Table 5 by fixing $\delta = 2.00$ a priori.

ward for the cash component and upward for its complement. (Compare the estimates in equation 6(d)(iv) with 6(e)(iv) and in 6(d)(v) with 6(e)(v) and 6(ē)(v)). The marginal propensity to spend on cash purchases is very high at 0.73 in the short-run and 0.71 in a steady state situation; for non-cash expenditure, the corresponding short-run estimates are around 0.17 while long-term estimates range between 0.25 and 0.27. Only a slight difference is evident between the short- and long-run expenditure and price coefficients (equation 6(e)(iv)), indicating that the adjustment mechanism of the cash outlays works speedily. As previously conjectured, the asymmetrical impact of the parity index on cash and non-cash components is brought out in a sharper focus. The pure substutition effect is positive for cash purchases and negative for its complement, as we would expect in a mutually consistent consumer behavior. The expenditure elasticity in the short-run, as well as long-run, turns out to be higher for the cash component than for the non-cash group. Its numerical magnitude amounts to 1.50 (short-run) and 1.55 (long-run) for cash and ranges between 0.29 and 0.31 (short-run) and 0.47 to 0.49 (long-run) for non-cash outlays. The demand with respect to parity index tends to be inelastic for both the groups, although its impact is positive for cash purchases and negative for its complement. These findings are in line with *a priori* reasoning that, in the long run, the effects of increased incomes (expenditures) and improved terms of trade would be reflected in a rural household's expanding demand for non-produced non-agricultural commodities.

Conclusions

As far as the author is aware, this study represents the first attempt at econometric analysis of monthly rural consumption expenditures with an explicit introduction of expenditure and price effects. Dynamic demand functions of a stock-flow variety are shown to be appropriate for this purpose.

By focusing attention on cash and non-cash (imputed) outlays on broad groups of consumption, this paper shows for the first time behavioral differences of rural households with respect to these components. Cash purchases act as an inventory adjustment mechanism, while non-cash outlays exhibit a habit persistence process. This finding may have far-reaching policy implications in projecting rural consumer expenditures in a predominantly agricultural, semimonetized developing economy in the process of industrialization.

Theoretical considerations suggested that the parity index may be an appropriate factor in explaining the rural household's consumption behavior Consequently, the parity index was introduced in the demand functions as an alternative predictor and found to yield plausible results, especially with respect to its asymmetrical impact on cash and non-cash components. Its inclusion also led to confirmation of the oft-repeated statement regarding the favorable effect of expanding incomes and improved terms of trade of agriculturists on their increasing demand for non-produced, non-agricultural commodities in the process of development. The significance of this phenomenon is stressed continually in theories of economic development.

Finally, numerical estimates have been obtained for the expenditure and price elasticities of cash and non-cash components of (a) expenditure on food articles and (b) total consumption expenditure. The instantaneous short-run and the steady-state long-run equilibrium values have been deduced in each case. The importance of this empirical information in formulating long-range development plans needs no special justification.

With regard to the shortcomings of our analysis, it may be noted that some important influences acting on the consumer expenditure were omitted, such as size and age composition of the rural families, wealth and liquid assets, etc. Also omitted from consideration was the simultaneity in decision making on the production and the consumption side.[9] Most important, the justly famous limitations of a repetitive, multi-purpose survey carried out by official agencies among poorly literate rural people apply equally to the data used in this paper. However, if plausibility of results may be taken as a confirmation of the overall accuracy, the data appear to do reasonably well.

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A Comparison of the Determinants of Wool Production in the Six Leading Producing Countries: 1949-1965*

WILLIAM H. WITHERELL

In this study, a general model of seasonal wool production is developed, based on the assumptions of (1) a lagged adjustment of actual to desired output, and (2) "naive" or "static" price expectations. The results of fitting this model to data from six major wool-producing countries for the seasons 1948-49 to 1964-65 indicate that wool production responds fairly weakly to economic factors and then only after a substantial lag. The estimates obtained of short- and long-run elasticities of wool production with respect to wool prices and the prices of the joint product, lamb, and the substitute products, wheat and beef, are all quite low. Australian wool production is found to be affected positively by fertilizer usage, and rainfall is found to be an important factor for wool production in Australia, South Africa and Argentina

WHILE some wool is produced in nearly every part of the world, the Southern Hemisphere countries of Australia, New Zealand, South Africa, Argentina, and Uruguay account for some 60 percent of the worlds' wool production, and Australia alone produces about 33 percent. It is the most important export of Australia, New Zealand and Uruguay. This paper describes an econometric analysis of the production of wool in the five countries mentioned, as well as in the United States, which produces about one-third of the wool it consumes. Seasonal data from 1948–1949 to 1964–1965 were used in the estimation. The study is part of a larger study of the world wool market [22] and was undertaken to provide production equations for an annual world wool market model. First, a theoretical model of the seasonal production of wool is described, followed by a discussion of the various data series used and some of the statistical problems faced in fitting the model to the time series data. Estimation results are then presented and compared for the six countries studied. Finally, some general conclusions are given about the nature of seasonal world wool production.

Constructing a General Model

Raw wool is obtained from the shearing of sheep, which have an average life of a little more than five years. The sheep are usually shorn first within

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one year after birth, and yearly thereafter. Because of the relatively fixed length of the production process and the importance of overhead costs,[1] the ability of wool producers to respond quickly to market expectations or actual market changes is quite limited, especially their ability to increase production. Short-run changes in the amount of wool produced may result from unfavorable weather conditions or an outbreak of disease. In many of the wool producing areas, lamb and mutton are important joint products; in these areas, producers are thought to base decisions as to the number of adult sheep and lambs to slaughter on the present and expected future relative prices of wool, lamb, and mutton.

In the longer run, wool producers make their production decisions by considering the relative expected returns of alternative uses of their resources—principally, growing cereal grains or raising cattle. However, a good proportion of the world's wool is produced in semi-arid and arid regions in which alternative uses of the producer's land may not exist; in such situations, the producer may have little economic choice, even in the long run, but to continue production even when market conditions become adverse. However, it should be noted here that in recent years, through the development and implementation of more advanced agricultural methods, specifically, the improvement of pastures by fertilization, seeding, and irrigation, and the control of diseases, predators, and competitors for the food supply, producers in the six countries under consideration have been able to increase significantly the yield per acre and per sheep of raw wool.

It was necessary to build into the wool production equations for each country the essential dynamic aspect that the level of a country's production of wool cannot be changed rapidly in response to changing economic conditions. This was accomplished by using the distributed lag model of supply adjustment developed by Nerlove in his studies of agricultural supply functions for the United States [13, 15, and 16]. In particular, letting Wj_t and Wj_{t-1} be the actual level of wool production in country j in seasons t and $t-1$, and Wj_t^*, the "desired" or "equilibrium" level of production in country j for season t, it is assumed that the change in actual production in season t over season $t-1$ is a fraction, B, of the desired or equilibrium increase. That is,

$$\text{(i)} \qquad Wj_t - Wj_{t-1} = B(Wj_t^* - Wj_{t-1})$$

The size of the fraction B, called the "coefficient of adjustment," is a measure of the speed with which actual production adjusts in response to factors determining desired production. This adjustment speed is determined by the biological production lag and by institutional, technological, and behavioral rigidities. Variations in rainfall and the use of fertilizer also are thought to affect this adjustment process; and when data on these factors were available for a country, the corresponding variables were added to (i) as additional linear terms.

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[1] G. Blau [1, pp. 191–192] finds that 65% of total producer costs are either fixed (independent of the volume of production) or "semi-variable" (only partly dependent on the volume of production).

It is important to note that equation (i) is a difference equation and that solving for Wj_t yields

$$\text{(ii)} \qquad Wj_t = \sum_{i=0}^{\infty} B(1-B)^i \, Wj^*_{t-1}.$$

That is, actual production in season t is a distributed lag function of current and past desired or equilibrium levels of production.

The desired level of production for season t, Wj_t^*, is assumed to be a linear function of the expected prices for season t of wool, Pw_t^e, and of other substitute (or perhaps complementary) products, for example, lamb, Pl_t^e; that is,

$$\text{(iii)} \qquad Wj_t^* = a + bPw_t^e + cPl_t^e + u_t$$

where u_t is a stochastic term. With the exception of the equations for Argentina and Uruguay, the results given in this paper assume that there is a two year lag in the initial impact of production decisions on actual output, due to the inherent difficulties of rapidly adjusting to changes in the market outlook. When compared with alternative assumptions of one to five year lags, this assumption yields the most satisfactory empirical results (except for Argentina and Uruguay, where a one year lag appears to be more appropriate) and is consistent with the basic biological lag in wool production. Thus, the expected prices and the desired output in (iii) are assumed to be from the viewpoint of season $t-2$. The simple model of price expectations used in this study is that of "naive" or "static" expectations; that is, we assume

$$\text{(iv)} \qquad Pw_t^e = Pw_{t-2}.$$

The price expected for season t from the viewpoint of season $t-2$ is the actual price in season $t-2$. Other simple models of price expectation were tried, specifically, that of "extrapolative" expectations in which estimates of future prices are made by extrapolating the current price adjusted for the most recent change in prices, and models which assume that the expected price is a weighted average of past prices (various arbitrary weighting schemes were used). However, these alternative simple models did not yield as reasonable results as did the "naive" model. The testing of more complex expectations models would require longer and better data series than those used in this study.

With the assumption of "naive" expectations formed in season $t-2$, equation (iii) becomes

$$\text{(v)} \qquad Wj_t^* = a + bPw_{t-2} + cPl_{t-2} + u_t.$$

The final form of the equations estimated in this study is obtained by substituting equation (v) into equation (i), yielding

$$\text{(vi)} \qquad Wj_t = Ba + (1 - B)Wj_{t-1} + BbPw_{t-2} + BcPl_{t-2} + Bu_t,$$

which is a linear equation in observable variables.[2] If the stochastic term u_t is not serially correlated in (v), there will be no serial correlation in the stochastic term of (vi).

The specification given in (i) and (iii) illustrates the Marshallian distinction between short and long runs, the use of the term "long-run" here corresponding to Marshall's use of the term "normal" [9, pp. 378–379]. In the short-run, the supply of factors to the economic unit, for example, a wool ranch, is relatively fixed; while as longer and longer runs are considered, the supply of factors becomes more and more variable and more alternative courses of action become available. As Nerlove notes [14, p. 235], "Thus, from any point on a long-run supply schedule, we may think of a fan of short-run supply curves which gradually approach the long-run supply schedule from the right above it and from the left below it." Since there is no one distinct "short-run" supply curve, the choice of which short-run supply curve to estimate is rather arbitrary. In our case, the decision to look at the two year supply curves (except for Argentina and Uruguay) was based on the purposes of the study, the nature of the production process, and the statistical results obtained. Moreover, what is observed is not the long-run supply curve but, instead, since the situation is constantly changing, points on the various short-run curves corresponding to no one supply curve. However, if the specification of (i), (iii), and (iv) is correct, estimates of the long-run supply curve and of a "short-run" supply curve for each country can be derived from estimates of (vi). That is, estimates of the "short-run" (two year) elasticities of supply, with respect to the explanatory variables, are readily obtained by multiplying the respective coefficients in (vi) by the ratios of the mean values of the explanatory variables to the mean value of supply. Estimates of "long-run" or equilibrium elasticities corresponding to equation (iii) can then be calculated by dividing the estimated "short-run" elasticities by the estimated value of B.

It should be emphasized that these structural inferences from the coefficients of (vi) are based on our assumptions of a lagged adjustment of actual to desired supply and of the determination of desired supply by naive expectations of prices, these expectations formed in season $t-2$. For alternatively, equation (vi) could be interpreted as the reduced form equation of a model in which wool production is determined by geometrically declining distributed lag functions of the actual prices of wool and lamb, where the lags begin in season $t-2$ and where both distributed lags are identical, having the same geometric weight B. However, it would no longer follow that, if the stochastic terms were serially uncorrelated in the original model, they also would be uncorrelated in (vi). Noting the similarity of these models, Griliches [6, pp. 16–17 and 42–45] indicates that it is very difficult to discriminate between them on empirical grounds. An interesting alternative to the model used in this paper would be one in which the dependent variable is specified to be a function of *different* distributed lags in the explanatory variables. For example, Martin [10 and 11] has estimated demand equations in which the explanatory variables enter with different geometrically declining distributed lags. Such models, however, are considerably more difficult to estimate; and because of the limited number of observations available for this study, this alternative approach did not seem feasible.

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[2] The author is not aware of any compelling reason to think that some specific non-linear form would be preferable. Yet, if the "true" structure is non-linear, equation (vi) may be considered to be a linear approximation of this structure; that is, the first terms in a Taylor's expansion of the non-linear form.

Data Considerations

Since wool production is seasonal (in most countries, from September to June), wool production and prices are expressed in seasonal terms in this study; and, where possible, so are the other variables used. The production data are expressed in terms of millions of pounds (clean basis);[3] and the price variable used is a weighted average of the seasonal averages of the Dominion wool price series for 64s and 46s (Bradford counts) wool, the weights being determined by the percentage of Merino and crossbred quality wool in the total wool clip. Thus, the price series is that of a composite quality wool. The Dominion wool price series are averaged weekly prices for the different qualities of wool and are compiled by the New Zealand Wool Commission on the basis of quotations from sales held during the week in the United Kingdom, Australia, New Zealand, and South Africa. These price series, quoted in terms of British currency, were converted to U. S. cents per pound (clean basis) at the then current exchange rate and then deflated by a seasonal index of world commodity prices, constructed by averaging the monthly Sauerbeck index of commodity prices from July to June. All other price series used are expressed similarly in terms of United States dollars. The price series for Australia, New Zealand, and South Africa were deflated by the Sauerbeck index of commodity prices; the prices for the United States, by the wholesale price index for farm products; and the prices for Argentina and Uruguay, by export price indices for these countries.

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[3] When raw wool is shorn from sheep, it contains a large amount of grease and dirt. Wool prices and trade are in terms of the expected clean content of the raw wool, and hence we express wool production on a clean basis. The wool data are derived from applying conversion factors, developed by the Commonwealth Economic Committee, to grease basis wool production series that are published in [21].

Fluctuations in rainfall have had a significant effect on wool production in many parts of the world, particularly in Australia, South Africa, and Argentina, where the sheep raising areas are subject to periodic droughts. Seasonal rainfall indices were used to account for the importance of this factor. The Australian Bureau of Agricultural Economics has constructed such an index for Australia by weighting the seasonal rainfall index for each state by the *average* percentage of Australian sheep in each state over the period spanning the seasons 1947–48 to 1964–65. This approach was followed in constructing the indices for the other five countries.

The Estimation Methods Used

In all of the forms of equations describing the production of wool that are considered, any explanatory variables that are currently endogenous to the rest of the wool market are excluded. That is, in a world wool market model, these equations would be recursive to the rest of the system. Hence, there should be no problem of simultaneous equation bias, and the method of ordinary least squares was employed to obtain initial equation estimates. However, a basic assumption of this method is that there is no correlation between the disturbance terms of different periods; and this assumption is often violated in the analysis of economic time series. When this is so, ordinary least squares estimated may be inefficient [8, p. 179]. Moreover, if in addition a lagged value of the dependent variable is included as an explanatory variable, as is the case here, Griliches [5] has shown that the ordinary least squares estimate of the coefficient, (1-B), of this lagged dependent variable will be biased. Since the estimates of the "long-run" elasticities depend crucially on the estimate of B, so that a small error in the estimate of B could cause a substantial error in the estimates of the "long-run" elasticities, such elasticity estimates should not be considered very precise when obtained from equations for which the disturbances appear to be serially correlated. Unfortunately, while the Durbin-Watson statistic [4] was developed as a test of the hypothesis that the residuals are uncorrelated, the significance tables computed by Durbin and Watson are not valid for equations containing lagged forms of the dependent variable. Nevertheless, the values of this statistic were computed for the wool supply equations in order to provide a rough comparison of the degree of auto-correlation present in the residuals of these equations. In cases where this statistic appeared to be "unusually" high or low, the equations were re-estimated by an approximation to generalized least squares suggested by Cochrane and Orcutt [2] and discussed by Johnston [8, pp. 193–194 and 197–199].[4]

In this method, it is assumed that the residuals are generated by a simple Markov process. The data are transformed by estimates of the auto-correlation coefficients of the residuals, and new estimates of the equations are obtained by applying ordinary least squares to these transformed data. In this study, the estimates of the auto-correlation coefficients of the residuals were obtained by regressing the residuals of the initial ordinary least squares estimates of the equations on their lagged values. Thus, the resulting estimates of the auto-correlation coefficients are biased. If the assumption about the Markov scheme is correct and if reasonably good estimates of the auto-correlation coefficients are obtained, the residuals from the equations using the transformed data should be uncorrelated. This procedure can be done iteratively, assuming successively higher order Markov schemes, but one degree of freedom is lost at each step. Because the number of available observations was small, only first and second-order Markov schemes were considered; and for most cases, these simple schemes appear to be adequate.

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[4] This approach is only one of a number of possible solutions to this problem. For other promising methods see [6] and the references cited therein.

Australian Wool Production

Australia produces about 33 percent of the world's wool, of which about 70 percent is Merino wool and 30 percent is crossbred wool. Wool production in Australia rose fairly steadily in the seventeen seasons studied, from 575.3 million pounds (clean basis) in 1948–49 to 1,031.5 million pounds (clean basis) in 1964–65. The major cause of this growth appears to have been the technological improvements made throughout that period—in particular, the increased use of superphosphate fertilizers on pastures and the control of rabbits by the planned spread of the disease, myxomatosis, and by poisoning. Fluctuations in rainfall are thought to be a major cause of year to year variations in Australian wool production, affecting both the size of the sheep population and the average fleece weight per sheep. The main economic factors appear to be the prices farmers receive for wool, lambs, and mutton, and for wheat, a major substitute crop in the large wheat-sheep areas of the country.

In the two versions of an Australian wool production equation given below—equations (1) and (2)—the dependent variable, Wau_t, is Australian wool production in season t, in millions of pounds (clean basis); and the explanatory variables are lagged wool production, Wau_{t-1}; the deflated world wool price in U. S. cents per pound for the season $t-2$, Pw_{t-2}; the deflated Australian wheat price in U. S. dollars per metric ton for the first calendar year of season $t-2$, Pwhau_{t-2}; the deflated Australian lamb price, in U. S. cents per pound for the first calendar year of season $t-2$, Plau_{t-2}; the use of super-phosphate fertilizers in thousands of metric tons in season $t-1$, Fau_{t-1}; and an Australian index of rainfall in season t, Rau_t.[5] Both equations were estimated by the Cochrane-Orcutt procedure, for the Durbin-Watson statistics for the ordinary least squares estimates of these equations indicated substantial negative serial correlation in the residuals. A first order Markov process was assumed to have generated the residuals.[6]

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[5] The wheat price used is the Australian Wheat Board's export price for fair-average quality wheat, bulk basis, f.o.b. at ports, and the lamb price is the wholesale price, slaughter weight at Melbourne, for first and second quality lamb. These prices and the fertilizer usage series are published in [20].

$$\begin{aligned}(1)\qquad Wau_t = &\underset{(.160)}{.473Wau_{t-1}} + \underset{(.323)}{.518Pw_{t-2}} + \underset{(1.600)}{3.476Plau_{t-2}} \\ &- \underset{(1.074)}{1.748Pwhau_{t-2}} + \underset{(.199)}{.583Fau_{t-1}} + \underset{(.366)}{.138Rau_t}\end{aligned}$$

$$R^2 = .99, \quad s.e. = 23.23, \quad D.W. = 2.71, \quad B = .527, \quad p_1 = -.580$$

$$\begin{aligned}(2)\qquad Wau_t = &\underset{(.141)}{.695Wau_{t-1}} + \underset{(.399)}{.660Pw_{t-2}} - \underset{(1.360)}{1.749Pwhau_{t-2}} \\ &+ \underset{(.208)}{.381Fau_{t-1}} + \underset{(.387)}{.569Rau_t}\end{aligned}$$

$$R^2 = .96, \quad s.e. = 30.42, \quad D.W. = 2.40, \quad B = .305, \quad p_1 = -.417$$

The numbers in parentheses beneath the coefficients are their estimated standard errors. For each equation, R^2 is the coefficient of determination, s.e is the standard error of estimate, *D.W.* is the Durbin-Watson statistic, *B* is the estimate of the coefficient of adjustment (from equations (i) and (vi)), and p_1 is the estimated first order auto-correlation coefficient of the residuals of the *OLS* estimate of the equation.[7] For these equations, the Cochrane-Orcutt procedure appears to remove some of the negative autocorrelation in the residuals, although the problem still exists in these estimates.

Equation (1) contains the lamb price variable, while (2) does not. The rainfall index enters both equations, but its coefficient is much less significant in equation (1). Although one would suspect that this difficulty is caused, in part, by a problem of multi-collinearity with respect to the independent variables, it is interesting to note that the simple correlation between the rainfall index and the lamb price series is only +.17. While other forms of these equations were estimated, dropping or adding variables and changing the lags, this ambiguity still remained.

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[6] The above equations do not contain constant terms because estimates obtained when a constant term was included resulted in intercepts not statistically different from zero, equations having worse statistical properties, and, in some cases, coefficients which contradicted rather firmly held *a priori* assumptions based on economic theory. Similar comments apply to the other equations in this study that lack constant terms.

[7] The high values of the R^2 statistics are not solely the result of including the lagged dependent variable. When equations (1) and (2) were estimated omitting the lagged dependent variable, the R^2 statistics were about .9 in both cases. The various elasticity estimates were also similar, lying between the short-run and the long-run estimates obtained here.

Equations (1) and (2) also differ with respect to the estimates of the coefficient of adjustment, B, that they yield, .527 from (1) and .305 from (2). Yet, both of these estimates indicate that the adjustment of actual to desired production levels in Australia is indeed incomplete after a lag of two years, for only one third to one half of the desired change occurs. Thus, the effects of changes in economic conditions and production are spread out over a number of years, as expected.

The "short-run" (two year) elasticities of supply to wool prices derived from (1) and (2) are quite low: +.066 and +.084, respectively. The latter estimate is very close to the two year price elasticity estimate of +.08 obtained by Dahlberg for the Wheat-Sheep Zone of South Australia for the period 1949–61 [3, p. 58]. The former estimate is close to the one year price elasticity estimate of +.0698 obtained by Powell and Gruen in their study of the Australian crop/pastoral complex covering the seasons 1947–48 to 1964–65 [18, p. 78; see also 17 and 19]. However, because of differences in the models and data series used in these studies, the resulting estimates are not strictly comparable with ours. The estimates of the "long-run" or equilibrium price elasticity of supply derived from (1) and (2) are +.125 and +.276, respectively, which seem to be quite low. However, such estimates depend crucially on the possibly biased estimates of the coefficient of adjustment and should be considered to be considerably less precise than the estimates of the short-run elasticity.

The lagged price of wheat, a major alternative crop in many sheep raising areas of Australia, enters with a similar negative coefficient in both equations, though the wheat price coefficient is less significant in equation (2). The short-run cross-elasticities of supply with respect to wheat prices obtained from the two equations are −.0456 and −.0457, respectively; and the corresponding long-run elasticities are −.087 and −.150. In comparison, Dahlberg [3, p. 58] obtained an estimate of −.42, indicating that a considerably stronger substitution effect between wool and wheat prices exists in the Wheat-Sheep Zone than in the country as a whole. This is to be expected, for it is in this region that most of the wheat is grown. Powell and Gruen [18, p. 78] obtained an estimate of the one year cross-elasticity of wool supply with respect to wheat prices of −.0521, which is much closer to our estimate.

The lamb price variable enters equation (1) with a significant positive coefficient, which would indicate that high lamb prices encourage the raising of more lambs, that is, the creation of larger flocks, rather than having the effect of decreasing sheep numbers as producers attempt to reap short-run profits from the then current high lamb prices. This result is quite reasonable, if the producers assume future lamb prices will be high when the current price is high. To slaughter more lambs would be to disinvest in lambs just when the expected future returns from lamb production rises. Yet, to an increasingly important extent, fat lambs are a specific product in Australia, usually being bred from an English-type breed of ram on cross-bred ewes. Since this type of lamb is unsuited for wool production, there is little chance that these lambs will avoid the slaughter house. However, the cross-bred ewes are dual-purpose animals, and in periods of high lamb prices, there may be less culling of the older breeding flock. The short- and long-run cross-elasticities of supply with respect to lamb prices implied by equation (1) are +.185 and +.351, respectively. In contrast to our results, Powell and Gruen [18, p. 78] obtained an estimated one year cross-elasticity of −.0177.

Finally, the fertilizer variable enters with the expected positive sign in both equations and seems to be a good proxy variable for technological changes in Australian production. These coefficients indicate that a *certeris paribus* increase in the use of superphosphate fertilizer of one thousand metric tons implies an increase in wool production in the following year of 381 to 583 thousand pounds (clean basis).

New Zealand Wood Production

The New Zealand sheep industry, second largest producer of apparel wool in the world, has a number of characteristics that differentiate it from that of Australia. Most of the New Zealand wool clip is of a coarser crossbred variety, grown on sheep more suited for the production of lamb than are the Merino sheep of Australia. In many areas, lamb production is the important crop and wool is just a by-product. However, there are no significant substitute farm crops. Variations in weather seem to have less effect on wool production in New Zealand than in Australia, and inclusion of a rainfall index in its equations yielded negative results. Finally, a Reserve Price Scheme, in operation since 1952, sets a guaranteed floor price for wool and thus protects producers from the more extreme drops in world wool prices. Because of this floor under wool prices, and because of the relative unimportance of droughts, annual wool production could be expected to vary considerably less in New Zealand than in Australia; and indeed, this was true over the time period studied.

The variables used in the two New Zealand wool production equations, given below, are current and lagged seasonal production in millions of pounds (clean basis), Wnz_t and Wnz_{t-1}; the deflated world wool price in U.S. cents per pound in season $t-2$, Pw_{t-2}; the deflated New Zealand reserve price for wool in U. S. cents per pound in season $t-1$, $Rpnz_{t-1}$ (this price is announced at the end of season $t-2$); and the deflated price of New Zealand lamb in U. S. cents per kilogram in the first calendar year of season $t-2$, $Plnz_{t-2}$.[8] Each equation was estimated by the Cochrane-

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[8] For the years prior to the creation of the Reserve Price Scheme, $RPnz_{t-1}$ was set equal to the deflated world wool price. The lamb price series used is the opening schedule price for top grade lamb determined by the New Zealand Meat Producers' Board, published in [20].

Orcutt procedure, assuming the residuals follow second-order Markov schemes.

$$(3)\qquad Wnz_t = \underset{(.021)}{1.003Wnz_{t-1}} - \underset{(.086)}{0.086Pw_{t-2}} + \underset{(.260)}{0.406Plnz_{t-2}}$$

$$R^2 = 0.99, \quad s.e. = 5.852, \quad D.W. = 1.71, \quad B = -0.003,$$
$$p_1 = -.650, \quad p_2 = -.284$$

$$(4)\qquad Wnz_t = \underset{(0.020)}{0.961Wnz_{t-1}} + \underset{(0.057)}{0.155RPnz_{t-1}} + \underset{(0.090)}{0.296Plnz_{t-2}}$$

$$R^2 = 0.99, \quad s.e. = 3.610, \quad D.W. = 1.86, \quad B = 0.039,$$
$$p_1 = -.959, \quad p_2 = -.542$$

The two different forms of the New Zealand equations were estimated in order to find out whether the reserve price or the actual wool price is most relevant to production decisions. In both cases, the Cochrane-Orcutt procedure seemed to work quite well, for the Durbin-Watson statistics for the ordinary least squares estimates of (3) and (4) were 2.9 and 3.2, respectively. Equation (3) is not very promising, for wool prices enter with the "wrong" sign and with little explanatory power, and the estimated coefficient of adjustment is negative. Equation (4) indicates that the reserve price variable has considerably more explanatory power with respect to wool production, probably because New Zealand wool producers are more concerned about a floor to their expected future earnings from wool sales than about attempting to forecast the fluctuations in world wool prices. Such behavior would be most probable for producers who consider lamb their main crop. If this inference is correct, one of the main objectives of the Reserve Price Scheme is being achieved—that of protecting wool producers from some of the extreme variations of the market and thereby stabilizing and encouraging production. The estimated short-run (two year) and long-run (equilibrium) elasticities of wool production to the reserve price obtained from (4) are 0.028 and 0.718, respectively. Because of the very small estimated value of the adjustment coefficient, the equilibrium elasticity is that corresponding to quite a long period of adjustment. While wool production appears to be stabilized by the Reserve-Price Scheme, the inelasticity of wool production with respect to the reserve price implies that it would be difficult for the New Zealand Wool Commission to use this policy variable to obtain a significant short-run increase in wool production. However, since the New Zealand reserve price was set quite conservatively throughout the observation period, it is difficult to estimate the effects of a more aggressive policy; for such a policy change might cause the price coefficient to change. The estimated short- and long-run cross-elasticities of production to lamb prices from (4) are 0.044 and 1.333, respectively. These results indicate that New Zealand wool production is more sensitive to lamb prices in the long run than that of Australia, as was expected, but the short-run effect is surprisingly low.

McMahnon [12, p. 38] states that the impact of technological change in New Zealand wool production has been quite impressive, with the stock-carrying capacity of some pastures being doubled in the last twenty years. However, we were not able to isolate any proxy variable for this technological change. When a fertilizer variable similar to that used in the Australian equations was included in (4), it entered with a negative sign and had no explanatory power.[9]

South African Wool Production

The wool industry of the Union of South Africa is in many ways similar to that of Australia. The climate in most sheep farming areas is very dry, with seasonal wool production affected by droughts in many years. Because of this climate, most of the sheep raised are Merino, grown only for wool production; hence, no lamb price variable was included in the South African equations. Wheat is a substitute crop for sheep farming only in some areas that are not too dry. South African wool production has not grown at the rate of Australian or New Zealand production, principally because of the prevalence of infectious and erosion diseases of sheep, the effects of vermin, and periodic droughts. Diseases and vermin have been difficult to control, but some progress has been made. In this area, as well as in improving water resources and fencing pastures, technological improvements have taken place; but because data are lacking, this factor was not included in the regressions. In March, 1958, South Africa began a Reserve Price Scheme similar to that of New Zealand, but the South African Wool Commission is at a disadvantage, compared with that of New Zealand, for it has less capital. Furthermore, South Africa does not have as strong a position in the world market in types of wool it produces. It is probably for these reasons that, unlike the New Zealand Wool Commission, the South African Wool Commission did not vary the reserve price during the period studied. However, the "real" value of this price has changed, because of changes in the deflator price index.

The data used in the two South African equations given below are current and lagged seasonal wool production in millions of pounds (clean basis), Wsa_t and Wsa_{t-1}; the deflated world wool price in U. S. cents per pound in season $t-2$, Pw_{t-2}; the deflated South African reserve price for wool in

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[9] The value of the coefficient of lagged production is probably unreasonably high in equation (4); and if so, this upward bias may be due to this lagged term picking up some of the effects of technological improvements in New Zealand sheep farming.

U. S. cents per pound in season $t-1$, $RPsa_{t-1}$ (this price is announced at the end of season $t-2$); the deflated price of wheat in U. S. cents per pound for the first calendar year of season $t-2$, $Pwhsa_{t-2}$;[10] and a South African rainfall index for season $t-1$, Rsa_{t-1}. The one year lag in this rainfall series was necessitated by the time period of the available series, and, therefore, the effect of droughts may be underestimated.

As a test of the effect of the Reserve Price Scheme, two equations were estimated, equation (5) containing just the world wool price variable and equation (6) containing also the reserve price variable. Because the observation period for which the Reserve Price Scheme was in operation is small, no equation was estimated with the reserve price as the only wool price variable. In the years prior to the formation of the Reserve Price Scheme, the variable $RPsa_{t-1}$, was set equal to zero. Thus, this variable probably should be interpreted as a "shift variable" in (6), indicating how wool production in the last six years compared with that of earlier years. Both equations were estimated by ordinary least squares.

$$(5)\quad \underset{}{Wsa_t} = \underset{(0.047)}{0.900Wsa_{t-1}} + \underset{(0.062)}{0.108Pw_{t-2}} - \underset{(0.068)}{0.079Pwhsa_{t-2}} + \underset{(0.074)}{0.141Rsa_{t-1}}$$

$$R^2 = 0.92, \quad s.e. = 7.840, \quad D.W. = 2.20, \quad B = 0.100$$

$$(6)\quad Wsa_t = \underset{(0.065)}{0.868Wsa_{t-1}} + \underset{(0.072)}{0.133Pw_{t-2}} + \underset{(0.060)}{0.044RPsa_{t-1}} - \underset{(0.070)}{0.085Pwhsa_{t-2}}$$

$$+ \underset{(0.076)}{0.151Rsa_{t-1}}$$

$$R^2 = 0.92, \quad s.e. = 7.984, \quad D.W. = 2.08, \quad B = 0.132$$

Equation (5) appears to be quite good, with the signs of all coefficients coinciding with *a priori* assumptions and with an acceptable value of the Durbin-Watson statistic, 2.20. The low value of the coefficient of adjustment, 0.100, indicates that the adjustment of production in South Africa in response to changing economic factors is indeed a slow process.[11] The rainfall index variable enters with the expected sign, the coefficient of 0.141 indicating that a drop in the index of 1.00 in one season causes a drop in wool production in the next season of 141 thousand pounds (clean basis). Over the observation period, this index has varied between a low of 51 and a high of 135. The estimated short- and long-run elasticities of wool production to wool price are +0.076 and +0.764, respectively, values similar to those estimated for New Zealand. The estimated short- and long-run cross-elasticities of wool production to wheat prices are -0.050 and -0.497, respectively, the short-run elasticity being very close to that estimated for Australia.

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[10] The wheat price used is the Government fixed price for wheat published in [20].

[11] Again, the lagged production variable may be picking up some of the effect of excluded technological improvement variables.

In equation (6), an estimate is made of the effect of the Reserve Price Scheme on South African wool production. The small positive coefficient of $RPsa_{t-1}$ suggests that the Reserve Price Scheme has had some effect in increasing wool production in the last six years of the sample period; but since the standard error of this coefficient is very large, this result is not conclusive. It is interesting to note that the supply elasticity with respect to Pw_{t-2} increases by some thirty percent when $RPsa_{t-1}$ is included. One would expect that the effect on this price elasticity would be asymetric, increasing the responsiveness of wool supply to price increases but decreasing the negative effects of price decreases.

Wool Production in Argentina and Uruguay

Argentina and Uruguay account for about 10 percent of the world's wool production, with Argentina producing wool of all qualities and Uruguay producing mainly crossbred wool. Wool production in Uruguay remained fairly constant over the sample period, while production in Argentina declined despite some attempts by the government to encourage production. A major factor in both countries has been unstable political climates accompanied by frequently changing export policies. In their attempts to fight inflation, balance of payments deficits, and other problems commonly faced by developing countries, the governments of these two countries sometimes have followed policies designed for revenue purposes and other times policies designed to stimulate exports. Another policy objective in Argentina has been to keep the cost of raw materials low for the growing domestic textile industry. The principal forms of government control in these countries have been export taxes, licenses and bonuses, and controlled exchange rates. The important effects of these changing policies on wool production greatly increase the difficulty of estimating supply equations for these two countries.

These difficulties are compounded by a lack of adequate data. In particular, no useable lamb price series was discovered for these countries. Also, while improvement of pastures contributed significantly to wool production in Uruguay during the sample period, no proxy variable for this pasture improvement was found. Finally, because of data limitations, the equations for these two countries were esitmated with data for 1950–1951 through 1964–1965, a sample period two seasons shorter than that used for the other countries in this study.

The major substitute products in Argentina are wheat and beef; in Uruguay, beef and hides (of cattle and sheep). Wool is Uruguay's most important product, accounting for as much as 60 percent of the country's export earnings in some years; and the importance of substitute crops is thought to be fairly small. In Argentina, the importance of substitute crops appears to be greater, except for regions in the far south. Rainfall in Uruguay is regular and adequate; and when a rainfall index was included in the Uruguay equations, the resulting coefficients were statistically highly insignificant. In contrast, the larger variations of seasonal rainfall in Argentina are thought to be a significant factor affecting wool production; and a seasonal rainfall variable is included in the final Argentine equation.

The resulting equations explaining wool production in Argentina and Uruguay are, respectively, equations (7) and (8) below. A one year lag is used in these equations instead of the two year lags used elsewhere in this study. When a two year lag was used, the results were even less satisfactory than these. The variables used in the Argentine equation (7), are Wag_t and Wag_{t-1}, Argentine wool production in millions of pounds (clean basis) in seasons t and $t-1$; Pw_{t-1}, the deflated world wool price in the United States cents per pound for season $t-1$; $Pwhag_{t-1}$, a deflated price of Argentine wheat in United States dollars per bushel for the first calendar year of season $t-1$; $Pbag_{t-1}$, a deflated price of Argentine beef in United States dollars per hundred pounds for the first calendar year of season $t-1$; and Rag_t, an Argentine rainfall index for season t.[12] The variables used for Uruguay in equation (8) are Wur_t and Wur_{t-1}, wool production in Uruguay in millions of pounds (clean basis) for seasons t and $t-1$; Pw_{t-1}, the deflated world wool price in United States cents per pound for season $t-1$; $Phur_{t-1}$, a deflated index of prices of Uruguayan hides for the second calendar year of season $t-1$; and $Pbur_{t-1}$, a deflated index of prices of Uruguayan beef for the second calendar year of season $t-1$.[13] Equation (7) was estimated by ordinary least squares; equation (8), by the Cochrane-Orcutt procedure, where the residuals were assumed to follow a second-order Markov scheme.

$$(7)\quad \underset{}{Wag_t} = \underset{(.178)}{.791\,Wag_{t-1}} + \underset{(.168)}{.010\,Pw_{t-1}} - \underset{(20.490)}{11.974\,Pwhag_{t-1}} + \underset{(1.883)}{1.769\,Pbag_{t-1}} + \underset{(.227)}{.305\,Rag_t}$$

$$\bar{R}^2 = .62, \quad s.e. = 16.718, \quad D.W. = 1.51, \quad B = .209$$

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[12] The Argentine wheat price series used is the support price for years 1948 to 1950 and the unit value of exports for years 1951 to 1964, and the beef price is the unit value of exports of foreign beef. Both series are deflated by an export index which is an index of Latin American export prices for the years 1948–1950, and an index of Argentine agricultural export prices for the years 1951 to 1964. All of these series are published in [7].

[13] The hide index for Uruguay is an index of unit value export prices of cattle and sheep hides and the beef price index is an index of unit value export prices of frozen and canned beef. Both series are published in [7].

$$(8) \quad Wur_t = .561\,Wur_{t-1} + .251\,Pw_{t-1} + .103\,Pbur_{t-1} + .194\,Phur_{t-1}$$
$$\qquad (.123) \qquad\qquad (.109) \qquad\qquad (.093) \qquad\qquad (.087)$$

$$R^2 = .66, \quad s.e. = 3.439, \quad D.W. = 1.86, \quad B = .439,$$
$$p_1 = -\,.221, \quad p_2 = -\,.280$$

These equations are not very satisfactory. The standard errors of most coefficients are high; and while the F test for the Uruguayan equation ($F=7.77$) is significant at the one percent level, the value for the Argentine equation ($F=4.50$) is significant at the five percent level but not at the one percent level.

Argentine wool production appears to be quite inelastic with respect to wool prices, the estimated short- and long-run price elasticities being +.042 and +.202. The wheat price enters the Argentine equation with an expected negative coefficient, the short- and long-run cross-elasticities being −.078 and −.322. However, the beef price enters with an unexpected positive coefficient. The weak explanatory power of both of these variables is probably due partially to the fact that wheat and beef are not significant substitute crops in the important sheep raising region of Patagonia. The rainfall index does have an expected positive effect on wool production in Argentina, a decrease of 1.00 in the index implying a decrease in production of 305 thousand pounds (clean basis).

The wool price coefficient in the Uruguayan equation is of the right sign and is statistically significant. The estimated short- and long-run price elasticities of supply are +.212 and +.481, somewhat higher than those for Argentina; and, in fact, the short-run elasticity is the highest estimate obtained in this study. The coefficient of the beef variable is also unexpectedly positive in the Uruguayan equation, as is the coefficient of hide prices. While there may be some element of complementarity between the raising of sheep and cattle in these two countries, these unexpected positive signs are more likely the combined result of mis-specified equations and inadequate data.

United States Wool Production

In a number of ways, the United States sheep industry is quite different from the sheep industries considered thus far. United States has a fully developed, highly industrialized economy; the agricultural sector does not dominate the economy; and the sheep industry is not the most important component of this sector. Also, United States wool is not produced for export, for the United States is a net importer of wool, producing only about thirty percent of the amount consumed. Wool is grown and marketed in many different ways here; hence, in aggregating "fleece wools" (grown on small eastern farms), "territory wools" (grown on the western ranges), and "Texas wools," grown on fenced pastures, the resulting equation explaining aggregate United States wool production may not be as satisfactory as the results for other countries where this problem was less severe. A final distinguishing characteristic of the United States sheep industry is that, in the years 1955–1965, United States wool production was encouraged to some degree by the government, farmers being paid an "incentive price" greater than the market price for their wool. In spite of such incentives, wool production has stagnated, falling slightly from 122.5 million pounds (clean basis) in the 1948–1949 season to 119.1 pounds (clean basis) in the 1964–1965 season.

Because of government support schemes, U. S. wool producers have been partially protected from the world market, and a new wool price variable had to be developed for the United States equation. First it must be noted that, since United States wool production (shearing) takes place in the spring, data are collected on a calendar year basis. For 1955 to 1965, the wool price variable most relevant to wool production appeared to be the government incentive price for wool, administered under the National Wool Act of 1954, for this price was always greater than the average price received by United States farmers. Incentive or support prices of some sort also existed in 1948 to 1954, but these were always lower than the average price received. Thus, the wool price series used, $Pwus_t$, is the average price received by farmers in cents per pound for 1948 to 1954 and the National Wool Act incentive price for wool in cents per pound for 1955 to 0965.

For a large segment of the United States sheep industry, lamb seems to be the major product; wool, a secondary joint product; wheat and beef, the two most important substitute products. Although variations in rainfall certainly must affect wool production in the more arid wool raising areas of the United States, inclusion of a seasonal rainfall index for the whole country yielded negative results. This may be because this index does not adequately capture differences in weather among the different regions of the country. Finally, no way was found to isolate technological change in wool growing, but omission of this factor seems less important for the United States during 1948–1965 than for the other countries studied.

The estimate of the United States wool production equation (9) given below explains Wus_t, United States wool production in millions of pounds (clean basis) in year t, as a function of Wus_{t-1}; $Pwus_{t-2}$, the deflated United States effective wool price in cents per pound (clean basis) for year $t-2$; $Pwhus_{t-2}$, the deflated United States price of wheat in dollars per bushel for year $t-2$; and $Pbus_{t-2}$, the deflated United States price of beef in dollars per hundred pounds for year $t-2$.[14] All prices were deflated by the United States wholesale price index for farm products.

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[14] The United States wheat price series used is the price of number 2 hard winter wheat in Kansas City published in [7]. The beef price series is the average price received by farmers published in [20].

Estimating the equation specified above for the years 1949 through 1965 with ordinary least squares yields

$$(9)\quad Wus = \underset{(47.521)}{96.901} + \underset{(.162)}{.548}\, Wus_{t-1} + \underset{(.151)}{.313}\, Pwus_{t-2} - \underset{(.154)}{.223}\, Pwhus_{t-2} - \underset{(.699)}{.641}\, Pbus_{t-2}$$

$$R^2 = .67, \quad s.e. = 5.39, \quad D.W. = 1.53, \quad B = .452$$

All of the variables enter (9) with the expected signs. Adding a lamb price variable, $Plus_{t-2}$, the deflated United States price of lamb in dollars per hundred pounds for year $t-2$,[15] to (9) yields

$$(10)\quad Wus_t = \underset{(77.348)}{83.592} + \underset{(.309)}{.606}\, Wus_{t-1} + \underset{(.180)}{.294}\, Pwus_{t-2} - \underset{(.154)}{.211}\, Pwhus_{t-2} - \underset{(.768)}{.695}\, Pbus_{t-2} + \underset{(1.327)}{.297}\, Plus_{t-2}$$

$$R^2 = .67, \quad s.e. = 5.39, \quad D.W. = 1.54, \quad B = .394$$

The coefficient of the lamb price variable has the expected (positive) sign but has a very large estimated standard error. The result is surprising, for lamb production is very important in many areas of the United States. Perhaps lamb production is not particularly responsive to lamb prices or the wrong lamb price variable was used. Since the estimates of the other coefficients of (10) seem less precise than those of (9), the following discussion concentrates on equation (9).

The estimated short- and long-run elasticities of wool production with respect to the United States wool price variable are +.145 and +.321. These are higher than most of the other estimates of price elasticities obtained in this study. The wool price coefficient indicates that a *certeris paribus* increase in the incentive price of wool of ten cents a pound would lead to an increase of about 3.1 million pounds (clean basis) in United States wool production in two years and a "long run" increase of about 6.9 million pounds. Yet this price was held at the same level in money terms since 1955, its "real" value varying only with changes in the wholesale index of farm products. These results suggest that a more vigorous use of the incentive price of wool would be an effective means of increasing United States wool production.

As for the other coefficients in (9), the estimated short- and long-run cross-elasticities of production, first, with respect to wheat prices, are −.387 and −.856; and second, with respect to beef prices, are −.100 and −.221. Thus, wheat appears to be a relatively strong substitute product and beef a weak substitute. The estimated coefficient of adjustment is .452, similar to the estimates for Australia and Uruguay.

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[15] The lamb price series used is the average price received by farmers published in [20].

Conclusions

In general, the statistical properties of the equations explaining wool production in the six major producing countries appear to be reasonably satisfactory, although the standard errors of some coefficients are too high. The *F* tests are significant at the five percent level for all equations, and at the one percent level for all except the Argentine and United States equations. From the viewpoint of economic theory, the main deficiency in all the equations is the absence of cost variables. Another deficiency in all but the Australian equation is the lack of a variable for technological change. Considerable research is needed in order to integrate these two factors into the supply equations. It would be desirable also to disaggregate the countrywide equations into different regions and for different qualities of wool, whenever the data permit. Yet, despite these deficiencies, the equations developed in this study appear to give the approximate structure of the production side of the world wool market.

Since these equations are similar in several respects, it is possible to make some general observations about world wool production. Table 1 gives a summary of the estimates obtained for the coefficients of adjustment, as well as the wool, lamb, and wheat price elasticities of supply. First, by using

Table 1. Summary of estimates of coefficients of adjustment and price elasticities of supply

		Coefficient of adjustment	Wool price elasticity		Lamb price cross-elasticity		Wheat price cross-elasticity	
			Short run	Long run	Short run	Long run	Short run	Long run
Australia	(1)	.527	.066	.125	.185	.351	−.046	−.087
	(2)	.305	.084	.276	—	—	−.046	−.150
New Zealand	(4)	.039	.028[a]	.718[a]	.044	1.133	—	—
South Africa	(5)	.100	.076	.764	—	—	−.050	−.497
Argentina	(7)	.209	.042	.202	—	—	−.078	−.372
Uruguay	(8)	.439	.212	.481	—	—	—	—
United States	(9)	.452	.145[b]	.321[b]	—	—	−.387	−.856
	(10)	.394	.136[b]	.346[b]	.048	.121	−.367	−.932

[a] These estimates are of the elasticity of New Zealand wool production to the New Zealand Reserve Price for wool.

[b] These estimates are the elasticity of United States wool production to the effective United States wool price as defined in the text.

a model incorporating an adjustment lag, this study shows that wool production is indeed quite stable in all of these countries, varying only slightly and after a long lag in response to changing economic factors. The estimated coefficients of adjustment range from an extremely low .04 for New Zealand to a high of .53 for Australia. The estimates of the elasticity of wool production to wool prices vary from +0.02 to +0.21 for the short run and from +0.12 to +0.72 for the long run. The inelasticity of wool supply to wool prices in all but the very long run is, therefore, an important aspect of the world wool market. The effects of substitute products (wheat, cattle) and of the joint product, lamb, on wool production also are estimated to be quite small. Thus, we would not expect to find in wool production the strong cycles that have been observed in the production of other agricultural products for which the supply responses to changing economic factors are considerably stronger, such as hogs in the United States. Instead, we would expect weaker cycles of fairly long duration; and such cycles have been detected by spectral analysis of wool production in Australia [22, Chapter 8]. There is considerable evidence, also, that the consumption of wool is quite inelastic with respect to wool prices [22, Chapter 6]. These results suggest that when supply or demand shifts due to some exogenous shock, such as a drought, or a recession in the consuming country, or a war, the resulting variations in wool prices and stocks will be much greater than they would be if these supply and demand relationships were more price elastic. Indeed, this has been the case in the post-war period during which world wool prices and stocks fluctuated very widely.

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Estimation of Performance Functions for Budgeting and Simulation Studies*

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This paper discusses the use of ideas from experimental design, and regression analysis, to increase the generality of result obtained from budgeting and simulation studies.

THIS paper discusses the problem of estimating the *functional relationship* between the variables used in budgeting and simulation studies and the use of these functions in deriving "performance statistics."

In particular, this paper considers the situation where a research worker has completed a major budgeting (or simulation) study and is thus in a position to state what outcomes would result under the assumptions made when specific values are assigned to the variables. These specific values of the variables might refer, for instance, to product prices (or price elasticities of demand), crop yields, labor requirements, weather variables, rate of interest, or the size of production quotas. The outcome of interest might refer, for example, to the present value of a project, maximum indebtedness, income variability, or rate of increase in production. In short, the completed study allows the impact of specific assumptions about the variables to be converted into estimates of the resulting outcomes.

The problem considered in this paper involves the derivation of more general functional relationships between the variables used in the study and the resulting outcomes. Once these functional relationships have been derived, the outcomes associated with given levels of the variables can be estimated directly from the functional relationship without having to go through the possibly tedious and costly process of inserting values for the variables in the budget or simulation.

If the research worker is considering a problem with a clearly defined objective function, and is interested only in the levels of decision (that is, controllable) variables, then it is reasonable for him to attempt to find the *optimum* level of these variables. Where the research worker is interested in optimization, he can use the approach suggested by Zusman and Amiad [8] or the ideas discussed in the engineering literature on control theory.

There are many instances, however, where the research worker is *not* faced with an optimization problem but has an estimation problem. The estimation problem can arise from either, or both, of the following considerations:

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(1) The components of the decision maker's objective function (such as debt and risk aversion) may be known, but their relative weights are unknown; or

(2) Some of the important variables used in the study (such as price) may be exogenous, and not under the control of the decision maker.

In these cases, the problem does not involve optimization; rather, it involves the estimation of the values of the components of the objective function that would be associated with particular levels of the decision and exogenous variables.

The ideas discussed in this paper are illustrated with reference to a budgetary study of the profitability of sheep farm development.[1] This study involved interacting occurrences of borrowing, taxation and debt repayment over a period of more than ten years. This meant that the construction of individual budgets to estimate present value and maximum indebtedness was extremely laborious and, in fact, involved the use of a specially written computer program. By using a central composite design[2] and completing the development budget for the 25 combinations of levels of four independent variables indicated by this design, it was possible to derive explicit functions of present value of farm development and maximum indebtedness in terms of the four major variables: wool price, stock prices, personal drawings and the price of fertilizer.

As shown in the conclusions to this paper, these performance functions allowed much more general conclusions to be drawn about the profitability of sheep farm development than would have been available from simple budgetary results.

Model Variables and Performance Statistics

Before proceeding, it is necessary to digress briefly to define some important components of budgeting and simulation models. *Structural parameters* are not subject to control by decision makers, but still determine the behavior of models. *Decision variables* also influence models' behaviour, but *are* subject to control by decision makers. The distinction depends largely on the level at which the decision maker operates.

In operation, a budgeting or simulation model generates *performance statistics*, which express the performance of the model. In this paper, we are concerned to express performance statistics as explicit functions, termed *performance functions*, of the structural parameters and decision variables.

If a model generates only one relevant performance statistic, or if the relative weights to be attached to multiple performance statistics are made explicit by the decision maker, we can talk of estimating an objective function. However, when we lack the relevant weighting information, it is reasonable to estimate the performance function for each of the performance statistics that may enter the ultimate objective function.

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[1] Cartwright [3, pp. 218–272].

[2] We shall discuss the rationale of using this design later in this paper.

Budgeting and Simulation

Deterministic budgeting studies generally involve point estimates of structural relationships and unique values of the decision variables. Each decision alternative being budgeted then provides single-valued estimates of the performance statistics. Simulation studies, on the other hand, usually involve well defined structural relationships and the variation of at least one decision variable.

Nevertheless, as mentioned above, budgetary studies become more flexible when variables are explicitly introduced.[3] At this point the methodologies of budgeting and simulation become almost indistinguishable, but it is notable that the performance statistics in budgeting studies are generally stated as explicit functions of the variables of the model.[4] Thus one suitable distinction between budgeting and simulation might be, "budgeting is a form of simulation in which the performance statistics are expressed as explicit functions of the variables in the model."[5]

For the balance of this paper, no distinction is made between budgeting and simulation studies.

Experimental Approach

If we represent the n performance statistics for a simulation model as S_i; $i=1, \cdots, n$ and the m variables of the model as x_j; $j=1, \cdots, m$, then there is some functional relationship between the statistics and variables:

$$S_i = f_i(x_1, \cdots, x_m); \qquad i = 1, \cdots, n. \tag{1}$$

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[3] The introduction of variables to represent prices and technical coefficients in budgeting is, of course, not new. This procedure has been called parametric budgeting [2, 7].

[4] See, for instance, Lloyd's [7, p. 8] budgetary equation for the net revenue per ton of hay conserved, as a function of the model parameters:

$$N = \frac{E}{5.5P}(10.6W - 185) - (H + 288)$$

where

N = Net revenue per ton of hay conserved (in pence),
W = Wool price net of marketing costs (in pence),
E = Technical efficiency of hay-making (in food units per ton),
P = Average period of feeding (in weeks per annum), and
H = Cost per ton of hay (in pence).

[5] This would mean, however, that in some "budgetary" studies involving for instance, farm development, decisions made over several years would need to be classified as "simulations." These long term development budgets frequently involve interactions between level of indebtedness, tax payments, and interest payments which are non-linearly related and extremely difficult, if not impossible, to represent as explicit functions.

The functions, f_i, may be extremely complex, but they can often be approximated by standard functional forms such as the polynomial. (In general, for curvilinear functions, the higher the order of the polynomial the better the degree of approximation.) Of course, prior knowledge could lead to the selection of functional forms other than polynomials. If there are *a priori* reasons for believing that the functions are of markedly different form in different regions of the performance space, a separate function could be used in each region to approximate (1).

For a discussion of the problems of:

1. Selecting an appropriate functional form for (1); and
2. Deciding on the optimum degree of replication if (1) is stochastic,

the reader is referred to the literature on experimental design as reviewed in Heady and Dillon [5]. This paper considers the use of a second order polynomial, though obviously other forms could have been used if *a priori* information had indicated that they were likely to give a better representation of the structure of the model.

To approximate the performance function (1), for the case where $n=1$ and $m=3$, by a second order polynomial, we would need to estimate the ten parameters of the following function:

$$(2) \qquad S = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_{11}x_1^2 + b_{22}x_2^2 + b_{33}x_3^2 + b_{12}x_1x_2 + b_{13}x_1x_3 + b_{23}x_2x_3.$$

To fit this equation, a minimum of ten runs of the simulation would be required with appropriate combinations of values of x_1, x_2, and x_3.

In practice, we would want to make more than ten runs of the simulation, since the extra observations would provide us with some measure of the likely error in using (2) to infer the value of S for non-simulated values of x_1, x_2, and x_3.

If the simulation model is non-stochastic, there will be only one outcome, S, for each set of x_1, x_2, and x_3, and hence re-running the simulation several times for the same set of parameters will not add any new information.

If a stochastic simulation is being used, however, replication (or re-running) of the simulation for given sets of parameters will increase the reliability of our estimates of the expected value of the performance statistic and provide information on the variance of outcomes at this particular point.

The form of the performance function (1) to be used and the selection of the number and location of parameter sets to be used for simulation runs both involve the same arguments about experimental design which arise in connection with the derivation of production functions [5]. The possibility of using gradient methods to locate the optimum operating conditions in a simulation study has already been noted by Zusman and Amiad [8]. However, whereas their objective was to locate a specific region or point on a performance surface, we are more concerned with estimating the performance surface *throughout* the space corresponding to selected ranges of the variables $x_1, \cdots, x_n$.

Numerical Example

The authors formulated the idea of deriving a performance function in connection with a substantial budgetary study of the potential for increased production on sheep farms in Wairoa County, New Zealand [3]. This study involved a fixed technical pattern of farm development over a nine year period and the examination of the financial implications of this development under a number of price and income assumptions.

Budgeting the implications of even one parameter set was quite complicated because of the interaction of taxation, interest paid, and overall level of indebtedness. In one case pay-back was predicted to occur in the 37th year!

The performance statistics of interest were:

S_1 = Present value of extra pre-tax cash profits,
S_2 = Present value of extra post-tax cash profits, and
S_3 = Maximum overdraft.[6]

The first of these performance statistics measures, in a sense, the worth of the development program to the nation. The second measures its worth to the individual undertaking the development, and the third statistic provides a measure of the financial feasibility of the development program.

The model variables of interest were:

x_1 = Price index for sheep and cattle,[7]
x_2 = Price of wool (net, greasy basis),
x_3 = Price of fertilizer (including application charges), and
x_4 = Lower bound on owner's annual personal drawings from the farm.

A second order polynomial equation was fitted for each performance statistic as a function of the four parameters, using a central composite design [1, 5] to define the levels of the variables to be used.[8] At each "treatment combination" (i.e., for each set of variables), the development program was budgeted (on the computer), and hence the values of the three performance statistics were obtained.

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[6] Expressed more descriptively, these performance statistics represent:
S_1 = Present value of the development program, if we ignore taxation (or assume a zero tax rate),
S_2 = Present value of the development program, if we treat taxation as a cost (just like fertilizer),
S_3 = The maximum indebtedness which has to be incurred to finance the program.

[7] The base index (=100) represented the prices that the authors believed most likely to rule in the future. Changes in the index should be interpreted as proportional changes in the prices of all sheep and cattle. The specification of separate indices (parameters) for different classes of sheep and cattle was not thought to be justified in the present study.

[8] When, as in our budgeting study, the cost of obtaining 'observations' of performance statistics is high, it is important to use a design which is efficient in yielding small magnitudes of residual sums of squares when the function to be fitted is given and the number of observations is fixed. The central composite design appears to be particularly suitable in this respect, although we do not claim that it is necessarily the most efficient design available.

To fit a second order polynomial in four variables, fifteen coefficients have to be estimated. The appropriate central composite design involves twenty-five "treatment combinations," so that for each equation ten degrees of freedom remained after estimating the fifteen coefficients.

The least-squares estimates of the coefficients for the polynomials, and the coefficient of multiple determination, R^2, appear in Table 1. We should be careful in interpreting these estimates. Note that the observations were known with *certainty*, so that the regression model was actually non-stochastic and did not conform to all the assumptions of the General Linear Model. Nevertheless, in these circumstances, it is permissible to use a least-squares procedure provided that R^2 is regarded as a measure of the adequacy of the polynomial in approximating the shape of the actual function. In a non-stochastic model, the standard errors obtained from least-squares regression have no meaning.

Table 1. Model development program—budgetary performance functions

Regression coefficient	Present value of pre-tax development cash profits	Present value of post-tax development cash profits	Maximum overdraft
b_0	154,280.29000	76,243.16700	−35,702.35000
b_1	292.84060	327.23935	−227.36661
b_2	3,107.10900	883.97287	−880.03005
b_3	−20,178.39000	−10,567.80200	8,124.19000
b_4	−118.73740	−45.77737	42.06840
b_{11}	4.77284	.43631	−.36150
b_{22}	−.61516	−.26265	.18215
b_{33}	568.58099	226.17605	−178.57379
b_{44}	.02448	.00951	−.00799
b_{12}	−21.13575	−11.65964	7.32207
b_{13}	−20.74922	6.08840	−4.36824
b_{14}	.31179	.06299	−.04526
b_{23}	40.83174	45.16394	17.38524
b_{24}	.52686	.39259	−.19627
b_{34}	.37018	−.32665	0.01724
R^2	.967	.994	.997

It will be noted that the coefficient of multiple determination, R^2, for the estimation of present value of extra pre-tax cash profit, S_1, is only .967 versus .994 for S_2 and .997 for S_3. While the relatively low R^2 for S_1 may warrant a more careful comparison of actual and estimated values of this statistic,[9] the authors would feel fairly safe in using all three functions to approximate the results which would be obtained by budgeting.

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[9] Even if the function estimating S_1 had proven unacceptable, this result would not have

Interpretation of the Performance Function

An initial, slightly ironic, observation is that the derivation of acceptable performance functions presents the analyst with an almost embarrassing amount of information.

More specifically, the performance functions allow estimation of:

1. Performance statistics (in this case, budgeting outcomes) for any reasonable values of the variables $x_1, \cdots, x_n$;
2. Estimation of the slope of the functions at any point; this allows measurement of the sensitivity of the performance statistics to marginal changes in the variables of the model; and
3. Location of break-even points; that is, combinations of the variables that result in performance statistics of zero.

The following examples illustrate the computations suggested above. The examples discussed are not, of course, exhaustive.

Point Response: Consider the question, "What would be the estimated present value of extra post-tax cash profits and maximum overdraft from the example farm development program if future prices are assumed to include stock prices at 120% of base prices, wool prices at 38.5d net, fertilizer costing £14/12/– per ton applied, and the lowest annual personal drawings that the farmer will tolerate are £1,050?"

Appropriate substitution in the response functions given in Table 1, gives estimated performance statistics of:[10]

Present value of post-tax development cash profits

$$S_2 = \text{£}112{,}729$$

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detracted from the usefulness of the technique. A third-order polynomial could have been fitted in an effort to obtain better predictions and still higher-order polynomials could subsequently have been tried. To fit a third-order polynomial, it would have been necessary to compute approximately 25 further evaluations. This did not seem justified. Alternatively, the second-order polynomial could have been fitted with the independent variables altered over smaller ranges. This could have increased the accuracy of fit.

[10] i.e., $x_1 = 120$, $x_2 = 38.5$, $x_3 = 15.6$ and $x_4 = 1{,}050$. Substituting in the appropriate function from Table 1, we have:

1. *Present value of extra post-tax cash profits*

$$\begin{aligned} S_2 = {} & 76{,}243.16700 + (120)(327.23935) + (38.5)(883.97287) \\ & - (14.6)(10{,}567.80200) - (1{,}050)(45.77737) + (120)^2(.43631) \\ & - (33.5)^2(.26265) + (14.6)^2(226.17605) + (.00951) \\ & - (120)(38.5)(11.65964) + (120)(14.6)(6.08840) + (120)(1{,}050)(.06299) \\ & + (33.5)(14.6)(45.16394) + (38.5)(1{,}050)(.39259) - (14.6)(1{,}050)(.32665) \end{aligned}$$

$S_2 = 12{,}729$, and

2. *Maximum overdraft*

$$\begin{aligned} S_3 = {} & -35{,}702.35000 - (120)(227.36661) - (38.5)(880.03005) \\ & + (14.6)(8.124.19000) + (1{,}050)(42.06840) - (120)^2(.36150) \\ & + (38.5)^2(.18215) - (14.6)^2(178.57379) - (1{,}050)^2(.00800) \\ & + (120)(38.5)(7.32207) - (120)(14.6)(4.36824) - (120)(1{,}050)(.04526) \\ & - (38.5)(14.6)(17.38524) - (38.5)(1{,}050)(.19627) - (14.6)(1{,}050)(.01724) \end{aligned}$$

$S_3 = 16{,}668$

Maximum overdraft

$$S_3 = £116{,}668$$

Thus, the derived functions may be used directly to estimate budgetary outcomes. It is important to note that extrapolation of the performance functions outside the ranges of values used to obtain them is unlikely to give reliable estimates of the performance statistics. Point responses could, of course, be obtained by direct budgeting, but our procedure promises to be less costly when individual budgets are complex and several point responses must be evaluated.

Graphical representation: If two of the parameters are set at constant levels, it is a simple matter to graph the performance statistics in terms of the other two parameters. Three of the possible graphs which could be drawn are shown in Figure 1, illustrating the ease with which the performance function can be interpreted. The curved lines are *iso-performance curves;* that is, the budgetary outcome is estimated to be constant with respect to a particular dimension (S_2 in these graphs) along any particular curve.

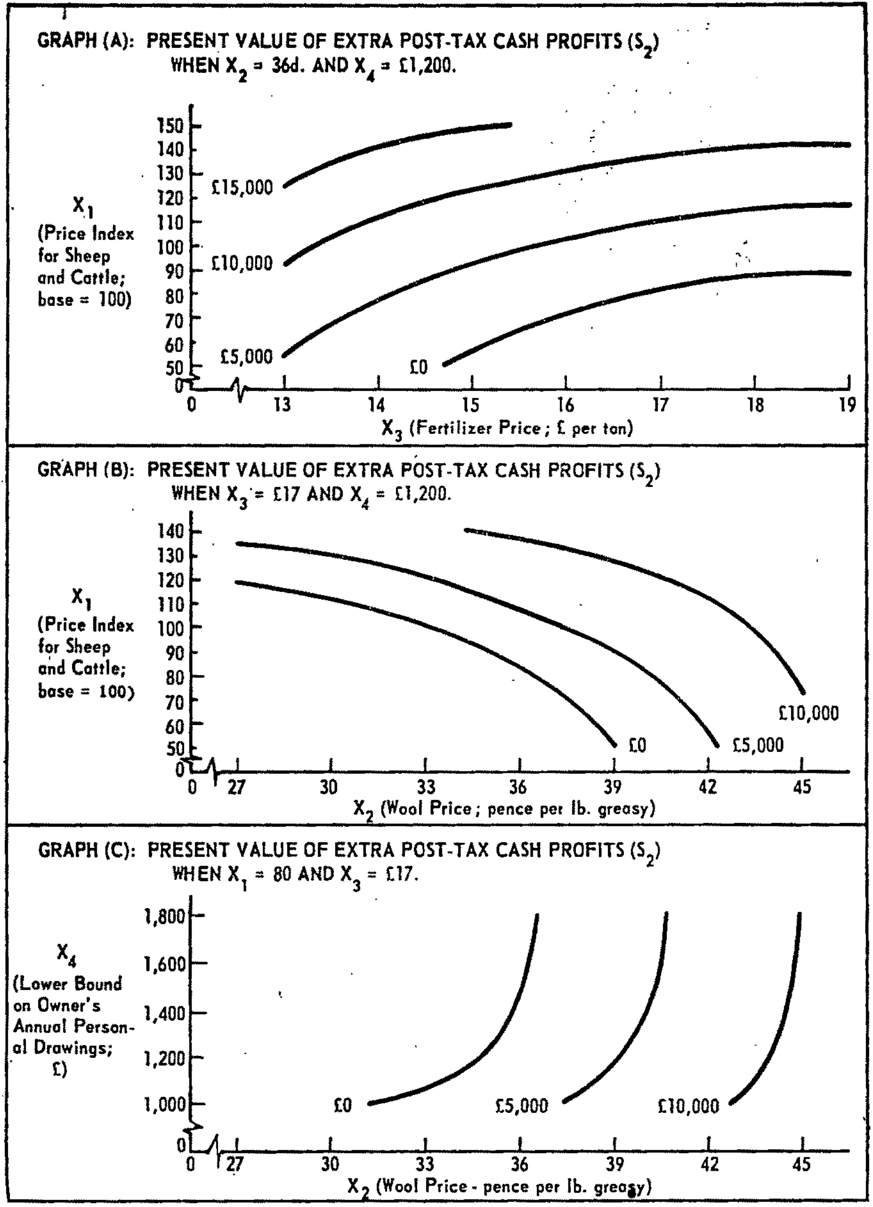
Graphs (A), (B), and (C) in Figure 1 show the effect on the estimated present value of extra-tax cash profits of varying x_1 and x_3, x_1 and x_2, and x_4 and x_2, respectively. The constant levels of the other variables are clearly indicated in each graph.

Sensitivity of performance function: The slope of the performance surface at any point denotes the sensitivity of the dependent variable to marginal changes in the independent variables. The slope of the performance surface with respect to a particular variable is obtained by taking the appropriate partial derivative of the function.

'Break-even' points: Suppose that we wish to obtain the values of the model variables for which the present value of extra post-tax cash profits, S_2, is zero. If three of the independent variables are set at particular levels, it is obvious that the S_2 performance function becomes a simple quadratic function in the remaining variable. For example, if the levels of x_2, x_3, and x_4 are regarded as constants, the response function may be written (in the notation of equation (1)) as:

$$(3)\quad S_2 = b_{11}x_1^2 + (b_1 + b_{12}x_2 + b_{13}x_3 + b_{14}x_4)x_1 + (b_0 + b_2x_2 + b_3x_3 + b_4x_4 + b_{22}x_2^2 + b_{33}x_3^2 + b_{44}x_4^2 + b_{23}x_2x_3 + b_{24}x_2x_4 + b_{34}x_3x_4).$$

This simple quadratic equation may then be solved for $S_2 = 0$. If real roots exist, and if at least one of these roots is within the specified range of x_1, then the 'break-even' level of x_1 (at the assumed combinations of levels of x_2, x_3, and x_4) will be obtained. Otherwise, no 'break-even' level exists within the range of the function.



GRAPH (A): PRESENT VALUE OF EXTRA POST-TAX CASH PROFITS (S_2) WHEN X_2 = 36d. AND X_4 = £1,200.

GRAPH (B): PRESENT VALUE OF EXTRA POST-TAX CASH PROFITS (S_2) WHEN X_3 = £17 AND X_4 = £1,200.

GRAPH (C): PRESENT VALUE OF EXTRA POST-TAX CASH PROFITS (S_2) WHEN X_1 = 80 AND X_3 = £17.

Figure 1. Iso-performance curves

Conclusions

Although the performance functions derived have not been examined in great depth in this paper,[11] the merit of the technique has been illustrated.

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[11] A more detailed numerical analysis of the estimated performance functions appears in [3]

The chief advantages that this technique adds to conventional budgeting or simulation are:

1. Given an acceptable derived function, performance statistics for an infinite number of combinations of prices may be estimated *without* recourse to additional budgeting or simulation. These estimates may be useful *per se*, or they may serve to suggest the price combinations for which further budgets and simulations should be carried out. It is a simple matter to construct graphs from which performance statistics can be 'read off'.
2. The sensitivity of performance statistics to price changes can be directly estimated from the derived function. This facility is simply not available from budgeting or simulation without the (at least implicit) calculation of performance functions.
3. Combinations of model variables which yield particular outcomes (e.g. zero profits) can be computed readily. Conventional budgeting and simulation can provide this information, but only through explicit search procedures.

The chief limitation of this technique is that the number of runs of the simulation required to estimate the response function increases rather rapidly as we increase the number of independent variables and/or the degree of the polynomial function being fitted. It would, for instance, be quite expensive to fit a second order polynomial with more than 8 independent variables.[12]

Finally, we may quote one paragraph of the conclusions from the study [3, p. 271] in which the above performance functions were derived:

"It was apparent that the development should remain profitable to the Nation over virtually all foreseeable price combinations. The analysis suggested that development should be profitable to farmers over most price combinations, although for wool prices lower than 33d and sheep and cattle prices lower than 75% of base prices, development could be unprofitable, particularly at fertilizer prices higher than £15 per ton."

Obviously, it would have been extremely difficult to be confident of this conclusion without the information provided by appropriate performance functions.

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[12] For appropriate search procedures for finding the optimum with more than 8 independent variables, see the work of Cyert and March [4, Chapter 8] and Hoggat and Balderson [6]. Where the research worker wants to estimate the performance function with more than 8 variables, the best approach is likely to be a more modest objective. The performance function with up to 8 independent variables can be estimated with other variables held constant (*ceterus paribus*). A variety of combinations may, of course, be chosen, so that several hyper-sections through the total performance function can be obtained.

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Reliability of Supply Equations Derived from Production Functions*

LARRY J. WIPF AND D. LEE BAWDEN

This paper examines the reliability of supply functions derived from empirically estimated production functions. Firm-level supply equations are derived from production functions for selected agricultural commodities, and these are used to predict firm output and to estimate supply elasticities. The results are then compared with actual or expected output and with supply elasticities estimated directly by regression analysis of time series data. Output predictions ranged from slight under-estimates to extreme over-estimates of actual output, with the latter being most prevalent. The derived supply elasticities were generally higher than those obtained by direct regression analysis.

MICROECONOMIC theory tells us that if factor prices are known and profit maximizing behavior is assumed, a firm's supply curve can be derived from its production function. Further, these individual curves can be summed to obtain the industry supply curve, assuming negligible or offsetting external economies and diseconomies of scale. Armed with such a simple and universally taught principle, it is perhaps paradoxical that empirical estimation of supply has rarely followed this approach, even in industries in which perfect competition is approximated. Most supply equations have been estimated directly by regression analysis of time series data, presumably in the belief that the derived supply approach is less accurate for both descriptive and predictive purposes. In a survey article on agricultural supply analysis, Nerlove and Bachman concluded that "too few studies have been conducted in which supply functions have been derived from production functions . . ." [3, p. 533], and suggested that this is one area which warranted some further research.

This paper reports an attempt to evaluate the descriptive and predictive reliability of the derived supply approach. Supply equations for individual firms are derived from production functions for a few selected agricultural commodities, and these are used to predict firm output and to estimate supply elasticities. These results are then compared with actual or expected output and with supply elasticities estimated directly by regression analysis of time series data. All production functions and direct regression supply elasticities are taken from secondary sources.

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* Helpful comments on an earlier draft were received from Peter Helmberger and A. C. Johnson.

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Theoretical Considerations

The mechanics of deriving a supply function from a production function are presented in numerous textbooks and will not be repeated here. However, it might be helpful to consider briefly the limitations embodied in this approach. Implicit in this derivation is that firms not only desire to maximize profits, but in fact are able to do so; i.e., all variable resources are available in unlimited quantity and are used at their economic optimum, firms possess perfect knowledge of present conditions, and future prices are known with certainty. The procedure usually ignores the effect on output of substitute and complementary production alternatives not now being produced. Finally, it is assumed that the basic production relationships can be accurately estimated.

On the positive side, the method of deriving supply equations from production functions can explicitly recognize varying degrees of asset fixity; hence, alternative supply functions corresponding to different lengths of run can be estimated. Also, some allowance can be made for technological change by using production functions estimated at different points in time.

The more common method of estimating supply relations, by regression analysis of time series data, attempts to measure how producers have reacted in the past to changes in relevant variables, rather than how they *should have* reacted according to the profit maximizing criterion. This approach can incorporate the effects of substitute and complementary production alternatives. Obviously, predictions are based upon the assumption that producers will continue to act in the future as they have in the past.

Empirical Comparisons

A large number of commodity and "whole-farm" production functions have been estimated for various agricultural sectors.[1] Some of these are utilized in this study to evaluate the usefulness of the derived supply approach in predicting output and estimating supply elasticities.[2] Unless otherwise stated, the supply equations are based on logarithmic production functions fitted to individual farm, cross-sectional data.

Some supply equations were derived from production functions for crop- and livestock-type farms in various regions of the United States in 1950. These equations were then used to predict firm output and to estimate supply elasticities. The results are shown in Table 1, and compari-

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[1] For a partial survey of these, see Heady and Dillion [1].

[2] Quite a few production functions fitted to agricultural data could not be used because prices or price indices for the input categories were not available or because they were incompletely reported.

Table 1. Output predictions and supply elasticities for various regions of the United States, 1950

Equation	Commodity	Area	Predicted output based on derived supply	Mean output of farm sample	Elasticity from derived supply	U.S. supply elasticity from direct regression
1	Crop	Montana	$ 60,630	$21,419	1.383	
2	Crop	N. Iowa	7,672	8,551	.197	.164–.172
3	Crop	S. Iowa	5,674	4,777	.647	
4	Crop	Alabama	1,329	1,322	.861	
5	Livestock	Montana	169,000	12,084	14.873	
6	Livestock	N. Iowa	15,710	13,943	9.718	
7	Livestock	S. Iowa	215,800,000	9,067	54.556	.194–.303
8	Livestock	Alabama	977	1,336	2.893	

Sources:

Production functions: Earl O. Heady and Russell Shaw, "Resource Returns and Productivity Coefficients in Selected Farming Areas," *J. Farm Econ.* 36: 243–257, May 1954.

U.S. elasticities from direct regression: Zvi Griliches, "Estimates of the Aggregate U.S. Farm Supply Function," *J. Farm Econ.* 42: 282–293, May 1960.

sons are made of: (1) predicted (optimum) output per farm based upon the derived supply equation vs. the mean farm output of the sample, and (2) the corresponding supply elasticity vs. elasticity estimates from direct regression analysis. These estimates are for a short-run situation, in which land and labor in crop production and labor in livestock production are assumed fixed while capital services[3] are allowed to vary.

Predicted output per farm (optimum output consistent with profit maximization) from the derived supply equations corresponds fairly well with the mean output of the farm sample in five of the eight cases (equations 2, 3, 4, 6, and 8). Since capital is often limited in actual farm situations, one might expect predicted output to exceed the mean sample output, and this occurred in three of the five cases (equations 3, 4, and 6). Overestimation also resulted for equations 1, 5, and 7; but in at least the latter two cases, the degree of overestimation is extreme.

Unacceptable results may be due, in part, to the form of the underlying production functions.[4] The logarithmic function may yield unrealistic estimates of production coefficients (and hence of the derived supply function) at the extremes of the underlying data, since both increasing and decreasing marginal products cannot occur. In addition, the logarithmic production function imposes restrictions upon the *form* of the derived supply function, which may result in unrealistic predictions of output. In particular, if the sum of the exponents of the production function lies between one-half and one, the derived supply curve has a peculiar shape: given successive unit price changes, output increases at an increasing rate. This situation is more serious the closer the sum of the production elasticities is to one.[5] Thus, the logarithmic function might yield extremely large optimum outputs when the sum of the production elasticities approaches one. Such is the case with equations (5) and (7), the sum of the production elasticities (holding labor fixed) being .93 and .98, respectively.

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[3] In these production functions, all capital items were aggregated into one input, although the individual items have varying degrees of fixity. This indicates the desirability of disaggregating inputs into finer categories than the traditional land, labor, and capital if the production functions are to serve as a useful basis for less than long-run supply prediction.

[4] A variety of functional forms have been used in empirical estimation of agricultural production functions. For a detailed exposition of alternative functional forms and the restrictions they place on the derived supply equations, see the discussion by Tweeten and Heady [5].

Direct comparisons of supply elasticities are not possible, but a general comparison can be made between the derived regional elasticities and elasticities estimated by regression analysis for the entire United States. For the crop equations, the derived elasticities ranged from about 15 percent to 800 percent larger than the directly estimated U.S. elasticity. The derived short-run elasticities for livestock appear intolerably high. Again, this may be attributed, in part, to the choice of the underlying production function. The logarithmic function has a constant supply elasticity; as such, it probably does not adequately represent elasticities at all product price levels.

Some additional short-run elasticity comparisons for specific commodities as well as for an entire farm are shown in Table 2. In the production functions upon which the derived elasticities are based, land, labor, farm improvements, and working assets are held fixed while liquid assets and cash operating expenses are free to vary. Again the derived elasticities exceed those estimated directly by the regression analysis, the former ranging from three to thirty times the latter.

A principal advantage of the derived supply approach is that it facilitates output predictions and elasticity estimates for various lengths of run. Consequently, supply equations were also derived from four whole-farm production functions, two for crops and two for livestock, with various combinations of inputs held fixed. The resulting elasticities and output predictions are shown in Table 3.

The results appear over-sensitive to changes in the length of run. For example, based upon the 1945 crop production function for southwestern Iowa (equation 1), farm production varies from $29,310, with land, labor, and machine services held fixed, to $9.4 billion per farm, with only land

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[5] When the sum of the elasticities exceeds one, specific optimum output predictions are not possible because of increasing returns to scale. When such cases are encountered in the present analysis, one or more inputs are held fixed and short- or intermediate-run outputs and elasticities are derived.

Table 2. Comparison of derived and directly estimated short-run elasticities

Commodity	Year	Area	Derived supply elasticity	U.S. supply elasticity from direct regression (1929–1953)
Hogs	1939	Iowa	.656	.130
	1942		.541	
Beef	1939	Iowa	.384	.037
	1942		1.088	
Dairy	1939	Iowa	.988	.212
	1942		.821	
Total farm	1939	Iowa	.398	.094–.131
	1942		.585	

Sources:

1939 production functions: Gerhard Tintner and O. H. Brownlee, "Production Functions Derived from Farm Records," *J. Farm Econ.* 26:566–571, Aug. 1944.

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Total farm: Zvi Griliches, "Estimates of the Aggregate U.S. Supply Function," *J. Farm Econ.* 42:282–293, May 1960.

Table 3. Outputs and elasticities from derived supply equations for alternative lengths of run

Equation	Commodity	Year	Area	Fixed inputs	Predicted output	Estimated elasictity
1	Crop	1945	Southwestern Iowa	Land	$9,419,000,000	14.38
				Land & mach. Ser.	539,500	3.67
				Land & labor	48,420	1.51
				Land, labor, mach. ser.	29,310	.83
2	Crop	1954	East-central Iowa	Labor	66,680	3.76
				Land	25,640	1.78
				Land & labor	8,571	.33
3	Livestock	1945	Southwestern Iowa	Land	367,300	14.38
				Labor	7,568	2.16
4	Livestock	1954	East-central Iowa	Labor & bldg. space	11,560	3.81
				Labor, bldg. Space & miscel. livestock ser.	8,863	.23

Sources:

1945 Crop and Livestock: Earl O. Heady, *Productivity and Income of Labor and Capital on Marshall Silt Loam Farms in Relation to Conservation Farming*, Iowa Agricultural Experimental Station Research Bulletin 401, Oct. 1953.

1954 Crop and Livestock: Earl O. Heady and John L. Dillon, *Agricultural Production Functions*, Ames, Iowa State University Press, 1961, pp. 564–568.

held constant at 160 acres. The $9.4 billion output is due in part to a production function of nearly constant returns to scale; the sum of the production elasticities being .93. The corresponding supply elasticities range from .83 to 14.38, the latter over 17 times larger than the former. Similarly, the 1945 livestock estimates for southwestern Iowa (equation 3) seem to be over-sensitive to changes in the degree of asset fixity. On the other hand, somewhat reasonable changes in predicted output and supply elasticities are obtained from the 1954 crop and livestock production functions (equations 2 and 4).

Since the form of the basic production function is expected to have some influence on the accuracy of the derived supplies, an attempt was made to find different types of production functions for the same commodity. Estimated outputs and corresponding supply elasticities are shown in Table 4 for broilers, turkeys, hogs, and corn for each of the three basic forms of the production function—logarithmic, quadratic, and square root. The production functions are based upon experimental data. The derived supply equations are for the short-run, in which only the fertilizer input for corn and the feed input for livestock products are allowed to vary.

Estimated output and supply elasticities vary considerably by type of function. Elasticities are unrealistically high for all commodities using the logarithmic production function, and output predictions are clearly beyond existing technological capabilities. As before, this may be due in part to the sum of the production elasticities being somewhat larger than one half.

The quadratic yields a reasonable output prediction for broilers and somewhat realistic output and elasticity estimates for the first hog function and for corn. The negative supply elasticity for turkeys resulted from an unexpected sign of one of the production parameters.

Corn yields are realistic using the square root production function, and its derived elasticity compares favorably with that estimated directly by regression analysis. Here, too, one of the supply elasticities is negative (for the first hog function), indicating a problem with the sign of one or more coefficients of the production function.

Summary and Conclusions

Firm-level supply functions were derived from production functions for a variety of agricultural products and farm types. Supply elasticities and profit maximizing output were computed from these, and comparisons were made (1) with actual output and with elasticities estimated directly by regression analysis; (2) for different lengths of run using the same production function; and (3) among different types of production functions for a given commodity. The primary purpose was to ascertain

Table 4. Comparison of supply elasticities and estimated output from alternative types of production functions

Commodity	Logarithmic function		Quadratic function		Sq. root function		U.S. supply elasticity from direct regression	Approximate "expected" output
	Estimated output	Supply elasticity	Estimated output	Supply elasticity	Estimated output	Supply elasticity		
1) Turkeys—1955								
Gain/bird								
a) (0–6) weeks	9,973 lbs.	4.18						2– 4 lbs.
b) (6–12) weeks	995 lbs.	3.05						4– 8 lbs.
c) (12–24) weeks	202 lbs.	3.21	4.5 lbs.	−1.905	60.1 lbs.	27.003		8–20 lbs.
d) entire period							.539	
2) Broilers—1955 Gain/bird	179,430 lbs.	8.16	3.7 lbs.	.077	10.6 lbs.	.008	.678[a]	2– 4 lbs.
3) Hogs—1953 Gain/hog (35 lbs.—market)								
a) Exp. A.	7,235 lbs.	5.41	160 lbs.	.134	8.1 lbs.	−13.767	.130	165–215 lbs.
b) Exp B	2,797 lbs.	4.59	512 lbs.	.441	61.4 lbs.	.332		
4) Corn—1952 Yield/acre	643 bu.[b]	2.25	140 bu.	.054	120 bu.	.175	.090–.180	80–120 bu.

[a] Elasticity of supply for poultry with respect to broiler price.

[b] Yield above check plot levels.

Sources:

Production Function: Earl O. Heady and John L. Dillon, *Agricultural Production Functions* (Ames: Iowa State University Press, 1961); broilers, p. 333; turkeys, pp. 380–385; hogs, pp. 271–274; corn, p. 478.

U.S. Elasticities—direct regression: Turkeys: D. Lee Bawden, Harold O. Carter and Gerald W. Dean, "Interregional Analysis of the United States Turkey Industry," *Hilgardia* 37:458, June 1966.

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whether realistic supply functions can be derived from statistically fitted production functions according to the notion that a firm's supply curve is that portion of marginal cost above average cost.

Our results lend support to the position that derived supply equations are not empirically reliable. Specifically, our analysis suggests that:

A. Output predictions obtained from the derived supply approach do not exhibit a consistent magnitude or direction of bias—they range from slight under-estimates to extreme over-estimates of actual output, with the latter being the most prevalent.
B. Both casual observation and directly estimated supply equations show firms to be less responsive to price changes than indicated by supply elasticities derived from production functions.
C. Elasticities and output predictions based on derived supply functions appear over-sensitive to changes in the length of run.

Unacceptable results can be attributed to one or more of the following: (1) restrictions which the production function places upon the form of the supply function, (2) unrealistic assumptions of the derivation process, and (3) unreliable estimates of the production coefficients.

Selection of the proper type (form) of production function is important in supply derivation. Our findings support the belief that the logarithmic function in particular may lead to somewhat erroneous predictions if the sum of the production elasticities is larger than one-half. However, all or even most of the responsibility for the unrealistic elasticities and output predictions obtained in this analysis cannot be attributed to improper equation form. Moreover, it is not clear whether the remainder is due to unrealistic assumptions, or unreliable estimates of production coefficients, or both.

Obviously, the underlying assumptions of profit maximization, perfect knowledge, and unlimited quantities of variable resources are inconsistent with real-world conditions, and it would not be surprising if such simplifications contributed significantly to the unrealistic results. On the other hand, estimated production coefficients are often unreliable,[6] and derived supply equations are quite sensitive to any errors in these parameters. Even in those cases in which the estimated production coefficients seem to be highly significant and fit the data quite well, the predictive reliability of alternative production functions may vary substantially.[7] This suggests that the traditional tests of significance and correlation are not sufficient to establish the estimates as reliable representations of the true production relationships; thus, it might be useful for researchers empirically estimating production functions to routinely derive supply equations and compute optimum outputs and elasticities as another method of evaluating the production coefficients.

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[6] Hildebrand's findings for the Cobb-Douglas production function suggest that "stability in the productivity estimates or even stable patterns is lacking" when changes in time periods, farm groupings, and treatment of inputs are considered [2, p.901].

[7] This is analogous to the situation reported by Stollsteimer and others in their efforts to obtain cost functions from cross-section data. They concluded that ". . . the

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analysis of such cross-section data may result in high correlations and apparently significant regression coefficients without providing the basis for confidence in the results as even rough approximations of the basic cost relations involved" [4, p.87].

EDITOR'S NOTE: This section of the *American Journal of Agricultural Economics* may include comments on and replies to previous articles and other literature in agricultural economics, suggestions for improving the effectiveness of the AAEA, discussions of changes in emphasis needed within the profession, and contributions on other topics of interest and importance to agricultural economists. Manuscripts submitted for this section should be prepared in accordance with the guide appearing on the inside of the back cover of this issue and should not exceed 1,000 words.

Communications

LARGE FARMS AND ABOVE PARITY RETURNS: INSEPARABLE OR JUST GOOD FRIENDS?

In 1967 the U. S. Department of Agriculture published the results of its study of parity returns as a measure of the well-being farmers [4]. Parity returns were defined as the "income required to make the current rate of return to the labor, capital, and management employed in farm production equal to the current rate of return to comparable resources employed in other sectors of the economy" [4, p. 9]. In this study it was noted that in 1966 only the larger farms, those with $20,000 or more value of sales, had returns from farming that exceeded parity returns. These results were obtained for each of four parity returns standards employed in the study—the landlord and stockholder standards, each computed with and without capital gains. None of the smaller farm size classes received returns that averaged as much as 100 percent of parity returns by any of the four standards. And the percentage of parity returns declined from the largest size class to the smallest. Other commentators on the farm sector seem to have interpreted this as implying that only the large farmers are getting above parity returns, and conversely, that the secret to receiving above parity returns is to achieve a large volume of gross sales [2, p. 195; 3, p. 18].

Since the figures on which the USDA study is based are averages of farms grouped by value of sales, it is subject to the question of interpretation: How do these averages relate to the individual farms that make up the population? A study of individual farm data in Michigan provides some indication of the relationships between average figures and parity returns for the individual farms that compose these aggregates [1]. Data from Michigan State University's Telfarm recordkeeping project for 1965 and 1966 were used. Parity returns were computed in a manner approximating the "landlord standard," excluding capital gains, as used in the USDA study.[1] To illustrate the conclusions from the Michigan study, the results from 378 dairy farms for 1966 are given in Table 1.

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[1] The landlord standard assumes parity

Average data for the individual size classes showed the same general relationship as obtained by the USDA from the national data [Table 1, section I]. Class I farms, on the average, received returns from farming as a percentage of parity returns of 105 percent. This was the only size class to receive above parity returns and each successive class received a lower percentage of parity returns.

The quartile deviations associated with these median values indicate the wide range in parity returns received by the individual farms within each class. For example, while Michigan's class I dairy farms averaged above parity returns from farming in 1966, the actual percentages for the individual farms within one quartile deviation of the median ranged from 74 to 136 percent of parity returns. And the range for the median ± one quartile deviation for the class II farms was from 54 to 104 percent.

In order to see more clearly the degree of concentration, the proportion

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returns to be the value of a rental return on equity capital, plus a wage for the farm operator and unpaid family labor equivalent to what the labor could earn in other occupations. While the procedures for determining equity capital and labor differed somewhat from the USDA study, it is felt that this would not significantly alter the conclusions reached here. For details on the computations see [1].

Table 1. U. S. and Michigan statistics on parity returns, 1966

Item		Size of farm (Gross sales)		
		$40,000 unit & over	$20,000–$39,999	$10,000–$19,999
I. Returns from farming as a percentage of parity returns:				
A. U. S. farms, average	Percent	129		85
B. Michigan dairy farms,				
average	Percent	105	81	42
median	Percent	105	79	43
Q.D.[1]	Percent	31	25	16
II. Percent of farms with above parity returns:				
A. Michigan dairy farms	Percent	52	34	3
B. Michigan, all other farm types	Percent	47	32	19
III. Return to operator labor for dairy farms with returns from farming:[2]				
A. Above parity returns	$/hr.	5.2[illegible]	3.70	2.78
B. Below parity returns	$/hr.	.3[illegible]	.92	.17

[1] Q.D. = quartile deviation = $\frac{\text{3rd quartile} - \text{1st quartile}}{2}$

Median ± Q.D. will include approximately one-half of all observations.

[2] Residual return to operator labor with capital charged at 5.5 percent and unpaid family labor valued at $1.91 per hour.

Source: U.S. data is from the U.S. Department of Agriculture [4, table 8]. Michigan data is computed from Telfarm records.

of farms with above parity incomes within each economic class was computed [Table 1, section II]. This shows that even among those farms selling $40,000 and more of products, only one-half of the individual farms earned parity returns or better although the entire group averaged 105 percent of parity returns. And while the class II dairy farms averaged but 81 percent of parity returns, one-third of the individual farms received above parity returns. Similar proportions for classes I and II farms were also observed for all farms of other types in the sample, along with a few in class III. These results suggest that a greater proportion, but by no means all, of class I farms earn above parity incomes, but such incomes are not restricted to the larger farms. While there is a substantial relationship between size of farm and the percentage of parity returns received from farming, size alone does not guarantee above parity returns.

Failure to receive farm income above parity returns on a large size farm does not necessarily mean an inadequate level of family income. A net farm income of, say, $20,000 would probably be considered adequate to support most families. But if this net farm income were only 50 percent of parity returns, it would seem to indicate a relatively inefficient operation. Conversely, operators on some of the smaller farms may receive above parity returns, yet find the income level inadequate to support a family and insufficient to allow for future growth of the farm operation.

In the final section of Table 1 are given the residual returns per hour to operator labor on Michigan's dairy farms when capital and unpaid family labor were imputed at the assumed opportunity costs of 5.5 percent and $1.91 per hour, respectively. The farms are divided into those receiving above and below parity returns. These rates can be thought of as the average wage rate necessary in a nonfarm job for the operator to be economically as well off as in farming. In this context, it appears that many farmers in the below parity group may be tempted to move to a nonfarm job, even at relatively low rates of pay. While these rates would differ from one farm type to another and from year to year, they do illustrate the differences in opportunity costs which may provide an incentive for various operators to leave farming. And these operators will come from large as well as small farms.

The above comments are intended to supplement, rather than dispute, the results set forth in the USDA study. But we do feel that they suggest a need for further investigation of the distribution of parity returns within each size class for the various types of farms. Such information may materially aid policy decisions with respect to the farm sector.

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A LAWYER LOOKS AT WATER RESOURCE ECONOMISTS*

Water resource economists are somewhat unique among social scientists in that legal constraints on allocation and use of water make possible letter-perfect case studies which can ultimately result in the creation of policy. That is to say, water resource economists have the opportunity to help shape society's future by developing new systems of water law based on economic theory. This opportunity is not available to the same degree to other economists.

The dearth of specific proposals for legislative innovations suggests that water resource economists have not considered such recommendations as being within their province. Two potential roles exist for the economist interested in systems of water law. One, which is traditional, is merely to *identify* legal constraints; the other, seldom acted on, is to concentrate on *eliminating* such constraints.

A review of the literature supports this. Recognizing that history gives insight to strategies which in turn illuminate the mission pursued by water resource economists, I offer the following evidence.

The Tendency to Criticize. Criticisms of existing legal structures have been valid from the standpoint of economic theory. However, the very fact that such criticisms were not accompanied by constructive alternatives is evidence that economists traditionally have been interested only in constraint identification. Vague generalizations[1] are not constructive alternatives in the minds of those persons intimately involved with the legislative process. They would prefer concise proposals accompanied by detailed analyses of the results expected upon implementation.

Selecting the Proper Forum. The journals wherein water resource economists have published their research results are not the type which legislators are likely to read. To illustrate, one of the better interplays between law and economics appeared in the *Journal of Farm Economics* around the turn of the decade. But how many legislators or politicians read or were made aware of this interplay? Pathetically few, if any.

Selecting a forum in which to advance one's theories and hypotheses is relatively simple once the proponent has determined his major publication objective. Since it is difficult to find published research directed toward those concerned with the legislative

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* The author is indebted to Professors Harold F. Breimyer and Stephen F. Whitted for careful review and helpful comments.

[1] Such as advocating the pursuit of water quality problems and allocation procedures on a regional basis.

process, one must wonder what objectives have been pursued by water resource economists. It can be argued that they are more interested in receiving the professional acclaim of their colleagues than in advancing society by improving legal institutions.

The Tendency to Ignore Political Feasibility. That a few economists have adopted the elimination of legal constraints as their mission can be argued by virtue of their pleas for a system of negotiable water rights. While the theoretical attainment of "highest and best use" is a laudable goal, it is significant that there has been no mad rush by state legislatures to adopt the system. Thus, one might cast aspersions on its political feasibility.

Rather than assuming or ignoring political feasibility, I submit that economists should recognize its significance and increase their usefulness to society by turning their creative talents to developing innovative legislative mechanisms which *approximate* the results of the purely competitive market system and which are palatable to legislators and other policy makers.

The Failure to Bridge the Communications Gap. There is another explanation for the paucity of states adopting negotiable water right systems. A communications gap exists between economists and legislators, caused in part by the failure to select the proper forum as discussed, *supra.* A contributing cause is the failure to recognize that economists have the burden of bridging this gap.

It is simply unrealistic to expect legislators to seek the opinion of economists (or the members of any profession) with respect to a given legal area, especially when they have not been made aware of existing deficiencies. Thus, those sincerely interested in seeing new and improved laws enacted must take the initiative in presenting and explaining their case to lawmakers.

Concluding Comments. Water resource economists can fill either of two missions: (1) constraint identification, or (2) constraint elimination. Historical evidence (mainly published research) indicates that economists have traditionally confined themselves to identifying legal constraints—and that primarily to members of their own profession.

In some cases, a firm's immediately critical constraint may be a specific legal rule. Eliminating this constraint will permit a movement toward the optimal point of production. Generally this movement will be accompanied by an increased benefit from our water resources.

Identifying legal constraints is a condition precedent to their elimination. However, it is the latter which is of greater benefit to society. Thus, if water resource economists are to accept a charge to maximize their usefulness to society, they should reorient their research efforts and adopt as their mission not only the identification, but also the complete elimination, of all legal constraints.

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ECONOMETRICIANS AND THE DATA GAP: COMMENT

It has been said that, "if persons who oppose mathematical analysis thought of the economic world as one ruled by laws of mathematics and distribution theory, they would not object to mathematical formulations" [4, p. 137]. This is not necessarily so. For example, I have always been somewhat opposed to econometrics, not because of any preconception as to the nonmathematical nature of the economic world, but rather because, having worked with economic statistics all my professional life, I have a low opinion as to their quality in general, and think they are often unable to support the weight of econometric methods applied to them.

I am convinced, in other words, that some econometric model-builders fail to recognize that "the elaborate superstructures on many of their models rest on statistical data foundations of shifting sand—and not solid rock" [5, p. 413], as they hoped. Thus, while econometric methods may be able to "furnish scientific procedures for testing economic relations by experience" [4, p. 136], its results are nevertheless often awry simply because available statistics may be such an opaque glass through which to view "experience."[1]

Econometricians too often put the cart (intricate analysis) way out in front of the horse (reliable data). This was true when the Econometric Society was founded in 1930. In recent years, the horse has made much progress. But somehow, probably by main force and strength of econometricians' wishful thinking, the cart has stayed out in front and even lengthened its lead![2] The result has been some "important data gaps" [8, p. 1402], especially in the kind of detailed distributions, by size and by geographic area, which econometric models commonly require. Even where data *are* available, they are likely to be of poorer quality than is needed, but "the existence of error is too often ignored" [8, p. 1405]. And there may be an additional failure to recognize that, for use in econometric analysis, the data must be more accurate statistically and more refined conceptually than is usually necessary for other purposes.

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[1] I do not wish to be recorded as being opposed to all agricultural econometric analysis. Two years' service on the Doctoral Theses Subcommittee of the AAEA Awards Committee has been a real eye opener in this regard. When a competent analyst finds suitable data relating to an important problem, the results are inevitably good—and *can* be outstanding. Unfortunately, I must also report that some good work in old-fashioned prose, well written and rigorously reasoned, has been unjustly downgraded simply because it lacked the currently fashionable mathematics appeal!

[2] Demands of statistics users *always* outrun data available. This is inevitable and is known as Grove's Law of Scarce Numbers. Its most unfortunate aspect, however, is that good men, not finding the data they had expected, waste their time and talents on research that is purely technique-oriented. If the problems of agricultural economics—and there are some big ones—are ever going to be solved, it is necessary for current research to be problem-oriented, not technique-oriented. This latter type of research is the ultimate in current uselessness because it solves no problem of the real world. In most cases, moreover, it is also the ultimate in longrun, absolute uselessness because data needed to make the new techniques operational are not only unavailable but likely *never* to become available.

In its frantic search for suitable data, the growing army of econometricians and would-be econometricians has often latched on to sets of data of very doubtful validity. Such dubious data may have been cooked up for other and more legitimate purposes, with no thought that they would ever be used in such a demanding type of analysis. But the budding econometrician is a most uncritical data user, quite capable of badgering producers of the data until they give him whatever they have just to shut him up. He then feeds the data into computers—many of which would stand idle if the "gigo[3] principle" were honored in anything but the breach.

A good, horrible example of recent vintage is the study by Scott and Heady [9] of regional demand for farm buildings, in which the dependent variable is expenditures on farm buildings, as estimated in the Farm Income Branch of ERS. The national series on farm building expenditures was concocted, on the flimsiest of bases [6, p. 18], as a legitimate device for calculating *depreciation* of farm buildings, to be used as a production expense. And national depreciation has been allocated directly to the states and regions in proportion to the value of buildings [6, p. 18], which is also legitimate. But Scott and Heady allocated annual estimates of *expenditures* on the *same* basis [9, p. 186], and then fed the resulting garbage into the uncomplaining computer.

The results of this study, it is important to note, seem entirely reasonable to the casual reader. Indeed, they must have seemed so to the editor of this Journal, for otherwise he could not have published them. So it is only my *personal* knowledge that the data used are garbage, plus a strict application of the "gigo principle," that has led to such an unfavorable conclusion. Something was radically wrong with the Scott-Heady study—but what?

Churchill Eisenhart has emphasized that "clear statements of the uncertainties of reported values are needed for their critical evaluation" [2, p. 1201], and he has also elaborated on the various kinds of situations that may arise. But he could not be expected to mention the situation where econometricians stubbornly refuse to recognize that data available are inadequate for their purpose,[4] as was the case with Scott and Heady—and probably with many other econometricians who have not been caught!

A principal conclusion of the farm buildings study was that the "overall coefficients for deflated gross income are positive . . . and all are significant at the 1-percent level. Although the absolute values of the coefficients for gross income are relatively small, this variable has the greatest influence on investment because of its relative magnitude and variance" [9, p.

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[3] Garbage in, garbage out [1, p. 10]. S. S. Stevens, the Harvard psychophysicist, has said it more elegantly: "If something empirically useful is to emerge in the printout, something empirically meaningful must be programed for the input" [10, p. 849]. Stevens' article should be required reading for agricultural econometricians, for it would help to keep them humble, a consummation devoutly to be wished.

[4] Although he *does* mention a paper by L. M. Branscomb entitled, "The Misinformation Explosion! Is the Literature Worth Reviewing?" [2, p. 1204].

190]. But in the absence of any *real* information on expenditures for farm buildings, the national series has ordinarily been moved from one year to the next *in direct proportion to the change in gross income*. So we are impelled to ask: What have Scott and Heady discovered that is of any significance at all?

There is an important lesson here. Econometric methods are extremely powerful, and are quite capable of homogenizing, perfuming, and prettily packaging the worst kinds of data inputs.[5] And the rationalization of pure garbage is especially facilitated when various methods are tried in turn until one is found that works. Not only did Scott and Heady use inadequate data, they were also guilty of this trial-and-error type of malpractice.[6]

Agricultural econometricians are a special but proliferating breed who have come to believe that, since there is an obvious need for "hard, quantitative knowledge at all decision-making levels," there can be no excuse for its unavailability. Economic data are viewed as "observations generated by society," and if particular data are not to be found, obviously someone has been remiss in not recording them! In reality, of course, users of statistical data have acquired too much influence, for it is only *producers* "who know what the data are worth and what is involved" [11, p. 70] in their further development.

Statistical bricks are often made with little clay and less straw. Although seemingly solid to the casual observer, they will crumble under pressure—and only the brick maker knows this. For example, Arthur M. Okun told a Washington Statistical Society luncheon on March 13, 1968, that the United States has the best system of economic statistics in the world, so that he does not have to start an analysis by "forecasting the past," ignoring the fact that many, perhaps most, of our economic time series, now considered to be well established, got their start in just that way, and are not now, for their earlier years, nearly as accurate as is commonly supposed.

"We need restraint in using poor data, not just recognition of the need for good data while reaching for whatever numbers may be readily at hand" [3, p. 1593]. But since agricultural econometricians, whatever their other talents, have little talent for self-restraint, imposition of a professional code of ethics would seem to be the only solution. The first point in such a code would be that use of available data should not be "a reflex decision based on a burst of computation" [10, p. 854], but should instead be dependent on careful consideration, in a mood of thoughtful inquiry, of their adequacy for the purpose intended.

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[5] Stevens made this point too: "Mathematics, like a computer, . . . will process any input, however devoid of scientific sense, and it will bedeck in formulas both the meaningful and the absurd. In the behavioral sciences, where the discernment for nonsense is perhaps less sharply honed than in the physical sciences, the vigil must remain especially alert against the intrusion of a defective theory merely because it carries a mathematical visa. An absurdity in full formularized attire may be more seductive than an absurdity undressed" [10, p. 853].

[6] For example: (1) "A stock variable . . . was not used for farm buildings because unsatisfactory results were previously obtained" (p. 188); (2) "Several nonlinear models also were formulated and estimated. . . . However, none . . . gave results as satisfactory . . . as those obtained by the linear model" (p. 188); (3) "The ratio of livestock income to total farm income lagged one year was tried as an explanatory variable but proved to be nonsignificant" (pp. 188–9); (4) "Farm size in acres, tried unsuccessfully as an explanatory variable, is highly correlated with the time-trend variable" (p. 190); (5) "Several formulations of income variables were used. Gross income divided by the index of prices received by farmers gave the best statistical results" (p. 191); and (6) "The ratio of gross livestock income to gross farm income was tried unsuccessfully as an explanatory variable" (p. 193).

The second point would be that relevance of the particular model chosen should be considered in the same thoughtful spirit, and in the light of the data selected as suitable. Once chosen, moreover, the model should be retained. If it proves unworkable, then the project should be abandoned, for the process of trial and error is likely to use up the equivalent of more "degrees of freedom" than are present in the first place.

The third and final point of an ethics code would be that all econometric models should be validated, like any intelligence or aptitude test, *before* publication. Validation means performance testing over a period of time —at least two years in most cases—to see if the model can actually do what it is supposed to do. This involves, as Olman Hee has pointed out, testing for the "predictability of statistical models" [7]. "There is an urgent need for more emphasis on performance testing" [7, p. 1479], an activity generally avoided by agricultural econometricians in the interest of early, and premature, publication.

If an ethics code like this had been strictly enforced over the last five years, the result would have been to eliminate, not just the article by Scott and Heady, but perhaps half the contents of this Journal!

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ECONOMETRICIANS AND THE DATA GAP: REPLY

Perennially, or at least quadrennially, we econometricians must undergo absolution of our sins for thinking that the *amount* of change in economic variables as well as their direction of change would be desirable to know. Also, the omniscient tell us about the great unsolved economic problems of our time that we are sorely neglecting, with no indication as to what the problems are or how they are to be solved with only primeval tools.

It is interesting to note that—paraphrasing some of the comment—"What my company does is legitimate. What you do is illegitimate." The handbook Grove coauthored says the expenditures data come from sample surveys of expenditures and other sources of expenditures on farm buildings. It *does not* say they are spewed out by a number generator as a proportion of farm income. Additional *personal* contact with members of ERS (one of the authors of the article was an employee of ERS at the time) suggested the data were sufficiently good for econometric analysis. Apparently, Grove's *personal* knowledge is superior to our *personal* knowledge.

Also, the article was reviewed and approved for publication by ERS. But, of course, this is not the stamp of the Almighty himself, who hands down such revelations as Grove's Law of Scarce Numbers.

Farm building stocks and other questions slurred at in the comment were mentioned only briefly in the article, due to Journal space limitations. These and other findings are discussed more fully in Iowa State Research Bulletin 545, by the same authors.

Economists—even non-econometricians—rarely agree that there is only one model or one set of variables that is *the* model or *the* set for a particular economic relationship. Yet, in the name of chastity, the non-econometrician economist discards his own economic training when he castigates those who use the least cost mix (a larger amount of a low cost input-computer time and a lower amount of a high cost input-professional time) to investigate the relevant hypothesized models and variable sets.

Certainly, it would be a nice world if all data had no error; but lacking such a world, shall we turn back the clock to the 19th century, or do we do the best we can with what we have and go ahead from there? We opt for the latter!

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CONVERTING PRICE SERIES OF INTERNATIONALLY TRADED COMMODITIES TO A COMMON CURRENCY PRIOR TO ESTIMATING NATIONAL SUPPLY AND DEMAND EQUATIONS*

In recent studies by Bjarnason [2], McGarry [3], and Schmitz [4], an algorithm for interregional trade developed by Takayama and Judge [5] and modified for international trade by Bawden [1] was used to predict international trade in feed grains, beef, and wheat, respectively. This algorithm makes it possible to determine equilibrium commodity prices, consumption, production, and trade flows for each of the trading nations under alternative policy assumptions.

The above approach to the study of international trade requires estimation of supply and demand equations for each of the major trading nations.[1] Furthermore, in order to obtain equilibrium solutions, all price series used in estimating national demand and supply equations must be converted to a common currency. In the studies listed, the United States dollar was chosen because it is the most widely used international currency. Thus, for example, equilibrium prices in the United Kingdom and Japan are in dollars per unit of quantity rather than in pound sterling or yen.

When each country's commodity prices are converted to a common currency prior to estimating supply and demand relationships, it is a simple matter to convert to dollars all of the price time series used for estimation, using yearly exchange rates. However, with the occurrence of any devaluation or appreciation of a country's currency, the authors found it best to use a base exchange rate for conversion purposes rather than yearly rates. They also found that when a deflator is used, the selected indices must have the same base year as that chosen for the base exchange rate.

There would be no objection to converting each country's annual price to United States dollars according to the then exchange rate if the so-called "purchasing power parity theory" were in reality perfectly valid. This theory states that the exchange rates move directly with real purchasing power in the trading nations of the world. Thus, for example, if the United Kingdom experiences some inflation in any given year while the United States does not, the real purchasing power of a unit of British currency will decline while the real purchasing power of a unit of American currency will remain constant. The exchange rates will then adjust to reflect this change in relative purchasing power of the two currencies; and the pound, in terms of dollars, will diminish in value. This theory obviously does not reflect international monetary reality, at least on a yearly basis. Despite the fact that relative purchasing power of the British and American currencies varied considerably in the

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* The authors wish to thank Professors D. L. Bawden and R. E. Baldwin, University of Wisconsin, for their helpful comments.

[1] Point supply and demand estimations were made for other trading areas. It was also necessary to construct a matrix of transfer costs between each of the specified production and consumption centers.

18 years since 1949, for example, it was not until November, 1967, that the pound sterling was devalued to reflect the change.

Suppliers and purchasers of any given commodity, in making their production and consumption decisions, are primarily interested in the movements of prices in terms of their country's currency; that is, the absolute yearly movement in the price of the commodity and the relative movement in prices of other relevant commodities. Since the parity theory does not hold, these movements can be reflected by using a base exchange rate. This is because the direction and magnitude of price movements in any country considered, in terms of United States currency, will be the same as the real direction and magnitude of price movements in the country in terms of its own currency.

The need to select a base rate rather than yearly exchange rates in converting prices to United States dollars is illustrated in Figure 1, in which supply and demand equations for commodity X are represented. Assume the exchange rate of United States dollars to Canadian dollars to British pounds is 1:1:0.5. Prior to devaluation, Canada exports Q_1Q_2 units of commodity X (the distance Q_1Q_2 equals Q_5Q_6—United Kingdom imports) to the United Kingdom. This is represented by the difference between Canada's domestic and total demand—DD and D_1D_1, respectively. The export price of \$1.00 per unit equals £0.5.

Assume a Canadian currency devaluation in 1965 of 10 percent. The exchange ratio between United States, Canadian, and British currencies then become: 1:1.10:0.5 and Q_1Q_2 of X (the amount prior to devaluation) can be imported by the United Kingdom at £0.45 per bushel. However, devaluation causes the Canadian total demand curve to move to the right to $D'_1D'_1$, resulting in increased exports. A new equilibrium price of \$1.05, which equals £0.477 at the new exchange rate, is established.

The effect of the devaluation, *cet-*

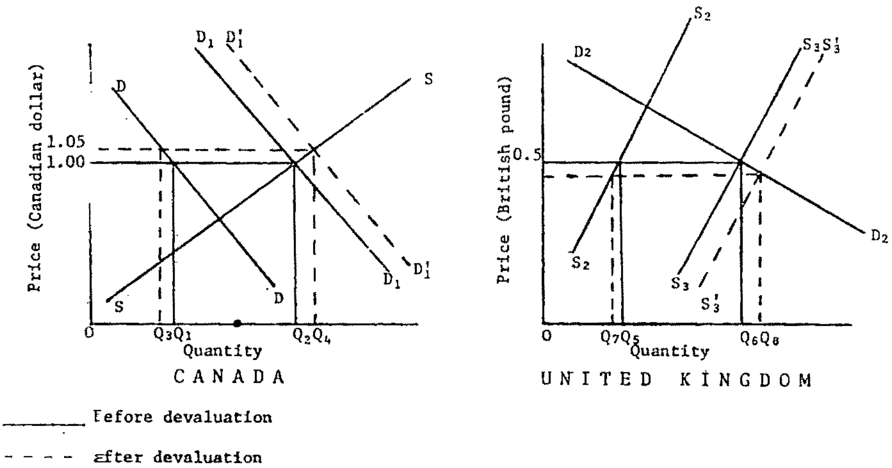

Figure 1. Devaluation and selection of exchange rates (transfer costs omitted)

eris paribus, causes Canadian production to increase from OQ_2 to OQ_4, domestic demand to decrease from OQ_1 to OQ_3, exports to increase from Q_1Q_2 to Q_3Q_4 (which equals United Kingdom imports Q_7Q_8), and the price of X to increase from \$1.00 to \$1.05 per unit.

Let us assume that Canada's supply and demand equations are estimated from time series data in which the last three price observations (1963-1965) are \$0.95, \$1.00, and \$1.05 per unit. Before estimation, these prices are converted to United States dollars. If the 1965 exchange rate (1:1.10:0.5) is used, the three prices become 86.4 cents, 90.9 cents, and 95.4 cents per unit. However, if yearly exchange rates are used, the price series becomes \$0.95, \$1.00, and \$0.945 per unit since the exchange rate prior to devaluation was 1:1:0.5. But this is not the series of prices observed by producers since this shows Canada's 1965 price to be lower than the actual 1965 price. In terms of its own currency, and thus from the standpoint of its producers and consumers, Canada's 1965 price of commodity X was higher than the 1964 price.

This analysis illustrates that, if devaluation or appreciation of a country's currency has occurred over the time period used as data for supply and demand estimation, a base exchange rate is required to convert the price series of the trading countries to United States dollars. In the example, only a base rate can reflect the increase in domestic prices in Canada for commodity X ensuing from devaluation.

A case may also be made for deflating all time series of prices used if some of the countries in the model have experienced considerable inflation. In any country where there is a fairly rapid rise in prices, producers will recognize that the real value of the currency is not increasing at as rapid a rate as money prices. In such cases, they will adjust their selling and purchasing habits to a more realistic level of commodity prices. However, if the decision to deflate prices is made, the selected indices used must have the same base year as that chosen in selecting the base exchange rate (1965, in the example above).[2]

In conclusion, one additional complexity is added to the vast array of those already encountered in statistical estimation of supply and demand responses for agricultural commodities. When dealing with internationally traded goods in the framework described at the outset, the supply and demand equations for each country need to be estimated, using price series which have to be converted to a common currency. With reference to the empirical studies alluded to, it was found that unless precaution is taken in selecting exchange rates and price deflators, the price and trade predictions are less than favorable.

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[2] For an illustration of the need to use a deflator and the difficulties involved if the base year chosen for the index is anything except the base year of exchange rates used, see Harold F. Bjarnason, "An Economic Analysis of 1980 International Trade in Feed Grains," unpublished Ph.D. thesis, Department of Economics, University of Wisconsin, 1967, footnote 16, pp. 42 and 43.

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EFFECTS OF NONPRICE VARIABLES UPON PARTICIPATION IN WATER-ORIENTED OUTDOOR RECREATION: COMMENT

A recent article in this *Journal* by Gillespie and Brewer [3] is susceptible to critical comment in several respects; it is deserving of commendation in others. Let me deal first with the latter category.

That the measurement of recreation demand is not a naive empirical "trick" remains to be proven to some economists—and to many noneconomists. It has been argued elsewhere that the treatment of recreation demand fits quite easily within the framework of general demand analysis [5]. The exact formulation of the demand model may vary with the research objectives, but the validity of including both price and "shifter" variables (income, age, education, etc.) is not in doubt. The Gillespie and Brewer attempt to obtain empirical estimates of the relationships between quantity and the various shifter variables is to be complimented—we know all too little about the magnitudes of these relationships.

On the other hand, the estimation of parameters in a model such as the authors describe would seem to be quite sensitive to model specification and to the extent to which the assumptions of the model are satisfied. In addition, the generality of the results would seem to be quite sensitive to the nature of the recreation activities and to the characteristics of the population. Along these lines, I should like to make four critical comments on the Gillespie-Brewer model and empirical results, and on their interpretation of the state of the arts in recreation demand measurement.

1. On the state of the arts, I would argue that the Hotelling-Clawson approach [2, 4] can easily be extended into a more general demand analysis by inclusion of relevant variables in addition to transfer costs [5]. Some of these variables, such as recreation quality, may be difficult to measure; nevertheless, a theoretical framework exists. Further, empirical estimates of price, income, and other parameters have been obtained in a number of studies, as, for example, in the Oregon salmon-steelhead study [1]. The Hotelling-Clawson model, I would argue, is a naive demand model in the sense that only quantity and proxy price

variables are included. It is not inconsistent with a more general demand model; rather, it is incompletely specified.

2. I am dubious of the validity of the Gillespie-Brewer assumption that prices were held constant by their procedure of sampling recreationists from a single "location," the St. Louis Metropolitan area. Their definition of the recreation area as a "vast rural mountainous area" implies that considerable differences in costs of travel may have existed within their sample of users.
3. To the extent that my second objection has validity, the parameter estimates are subject to biases in unknown directions. Even if my second objection has no validity, the lack of significance of four of the eight regression coefficients causes the elasticity estimates for income and age to be suspect. Considering the inherent problems of intercorrelation between the various non-price variables, one could be less critical of the empirical model if it were not presented as a predictive model capable of being generalized.
4. Although one objective of recreation research should be to strive for generality of results, I am not convinced that the present state of the arts is very far advanced toward this objective. Accordingly, the authors' claim for generality of their results should be viewed as a hypothesis rather than as a research result. The list of water-oriented outdoor recreation seems fairly inclusive, but no data are presented on the relative importance of the activities. More critically, the datum that 99 percent of the household heads in the survey were non-white can scarcely be consistent with the claim of a generalized predictive model. The present critic would be quite relieved to hear of a typographical error!

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EFFECTS OF NONPRICE VARIABLES UPON PARTICIPATION IN WATER-ORIENTED OUTDOOR RECREATION: REPLY

We wish to compliment Stevens on his thorough reading of the article and his knowledge and understanding of some of the more difficult problems encountered in recreation research which are too often so easily passed over by other researchers.

We are aware of and in full agreement with Stevens on the sensitivity of which he speaks. However, we do believe that the assumptions of the model were sufficiently satisfied. Assumptions and comparisons can be made by judgments of an essentially ethical nature and, if so made, can be formalized into an equation. However, if research should wait until an overall accepted detailed set of judgments were made by the research universe, we would not go very far in explaining a great deal of economic and social phenomena.

We would still argue with the Hotelling-Clawson approach, primarily from the basic problem of adequately dealing with variables other than those directly or indirectly associated with price, as we suggested in our article. (The sample method used by Clawson in obtaining his data is also questionable.) Also, computing costs from the concentric circle idea leaves much to be desired. This, and the difficulty of obtaining reliable data, leads us to believe that the Hotelling-Clawson approach is not as easily extended (with reliability) as Stevens suggests.

To the second critical comment, the sample universe (St. Louis) is so small geographically that costs faced by each individual sample unit can be logically viewed as constant. If Stevens is telling us it is more expensive to travel greater distances or spend more time away from home, and that there is a difference in travel conveyance modes, we would definitely agree. But this is not the point in question. We were concerned with the cost function of a potential recreationist. To clarify our reply to the second criticism, we will briefly state the two assumptions made: (1) the distance between sample units within the universe used was so negligible that the difference was insignificant, and (2) there are hundreds of recreational points within the Ozarks area adjacent to the metropolitan sample area.

The prices faced by each and every sample unit to point A are the same, likewise to point B, C, ... We had no intention of inferring that prices relative to point A, say 20 miles distant, were the same as to point B, 250 miles distant, or that there was constancy in price A relative to B. We believe the criticism arises from misinterpretation and not from a fundamental difference. If this is the case, we are fully to blame for not being more explicit.

Stevens notes that the lack of significance of four of the eight regressions coefficients causes the elasticity estimates for income and age to be suspect. This we do not deny. In fact, we warned that they were subject to error but did give a degree of reliability. Regarding the level of significance of the variables, it is an arbitrary decision by the researcher as to what level of significance he wishes to set. Consumer preference studies normally accept a lower level of significance than other traditional type studies. No judgment is made whether this is good or bad. The socioeconomic characteristics were entered as linear, quadratic and cross-product variables. The decision was made to include a socio-economic characteristic (income) if it was significant in one function, and had a value of approximately unity in another function. We felt that the bias resulting from leaving it out of the model would be greater than that resulting from retaining the variable. Actually, this allows one to measure the total net effect of a socio-economic characteristic, rather than only part of its influence. It is implied that if all eight coefficients were significant then we would be permitted to generalize. Would we not be just a little guilty of generalizing that another sample taken would yield same results? There is always a chance that our one rejection of the null hypothesis was one of those included in the 5% error specified as Type I.

We also believe that one objective of research should be to strive for generality of results, as Stevens suggests, but whether or not any one piece of research advances the state of the arts is normally a value judgment and time is required for testing. The authors did not have in mind the converting of followers as a major purpose of the research; they were merely reporting the results they found in extensive research using a different approach than has been customary. Whether the reader prefers to view the results as a generality, i.e., an acceptable test of an hypothesis, or as an untested hypothesis, lies completely with him.

Stevens admitted the list of water-oriented outdoor recreation seems to be fairly complete, but objected to the fact that we did not present a relative importance scale. This was not the purpose of the article and would have had little value to what we were attempting to report. The preparation of a research report is now under way that will present this data in detail concerning the relative importance of various recreation activities and preferences of the population for those activities.

In conclusion, we would like to say that the figure showing 99 percent of the household heads as non-white is an error. The correct figure should have been 9.9 percent non-white. Also, the coefficient for labor should be +6.55, not −6.55, in Table I, page 86. These are typographical errors and we apologize for our carelessness.

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ON DEFINING UNECONOMIC REGIONS OF THE PRODUCTION FUNCTION*

Discussions of symmetry of the three regions of production for a two-factor production function in economic theory texts often shed more confusion than light. The regions usually are defined implicitly or explicitly as follows:[1]

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* The authors wish to thank their colleagues and the two *AJAE* reviewers for their helpful comments.

[1] See Leftwich [7, p. 115]. Most texts

1. In region I, the average product of the variable factor is increasing and the marginal product of the fixed factor is negative.
2. In region II, the average and marginal products of both factors are decreasing and both marginal products are positive.
3. In region III, the marginal product of the variable factor is negative and the average product of the fixed factor is increasing (to the left).

The border between regions I and II is usually shown to be where the average product of the variable factor is maximum (See Figure 1).[2] Regions I and III are symmetrical, and the border between regions II and III for the variable factor occurs at the point where the average product of the fixed factor is maximum and equals its marginal product. Stigler points out in a footnote that regions I and III are symmetrical only when the production function is homogeneous of the first degree.

How does one define region II for functions not homogeneous of degree 1? Bilas [1, p. 126] doesn't choose a definition but states that region II, "as *traditionally* defined, is relevant only to a production function that is homogeneous of the first degree. The important concept is that a firm will produce in the region in which *both* marginal products are positive. Whether they [*APP*'s] are increasing or decreasing is of little importance." (Italics and brackets are added.) Although there is a consensus concerning the "rational region" of production for functions homogeneous of degree 1, this topic is not discussed for other functions in most texts. More important, few students at this level understand *homogeneity* (constant elasticity of production), and many confuse it with *linearity* (constant returns to scale). Mundlak [9] showed that it was very important to understand homogeneity in order to understand the traditional definition of regions of production.

Mundlak [9] defined the regions of production for the two-input case in terms of the average and marginal productivities for functions that are homogeneous of any degree. Region II for Mundlak, as for Bilas, is the region where the marginal products of two inputs are each positive. However, he concluded that the procedure for defining regions for nonhomogeneous functions remains "an open subject."[3] The shortcomings of this definition of region II will be illustrated following the presentation of our cost-oriented definition.

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refer to exceptions to symmetry of regions I and III in footnotes—or not at all. In addition to Leftwich's text, see, for example, Ferguson [4, p. 124]; Friedman [5, p. 130]; and Stigler [10, p. 126].

[2] The function used in plotting the curves in this note was

$$y = x_1^2 - 0.1x_1^3$$

which can be imagined to have come from the following function which is homogeneous of degree 1 in two inputs as follows:

$$y = \frac{x_1^2 x_2 - 0.1x_1^3}{x_2^2},$$

provided that $x_2 = 1$. It is easy to change the degree of this function. We substituted $x_2^{1.5}$ and $x_2^{2.5}$ for x_2^2 in the denominator to achieve the conditions imagined in Figures 3 and 4. See the note by Eichhorn [3] for an up-to-date view on the flexibility of the linear homogeneous production function.

[3] See Mundlak [9, p. 761].

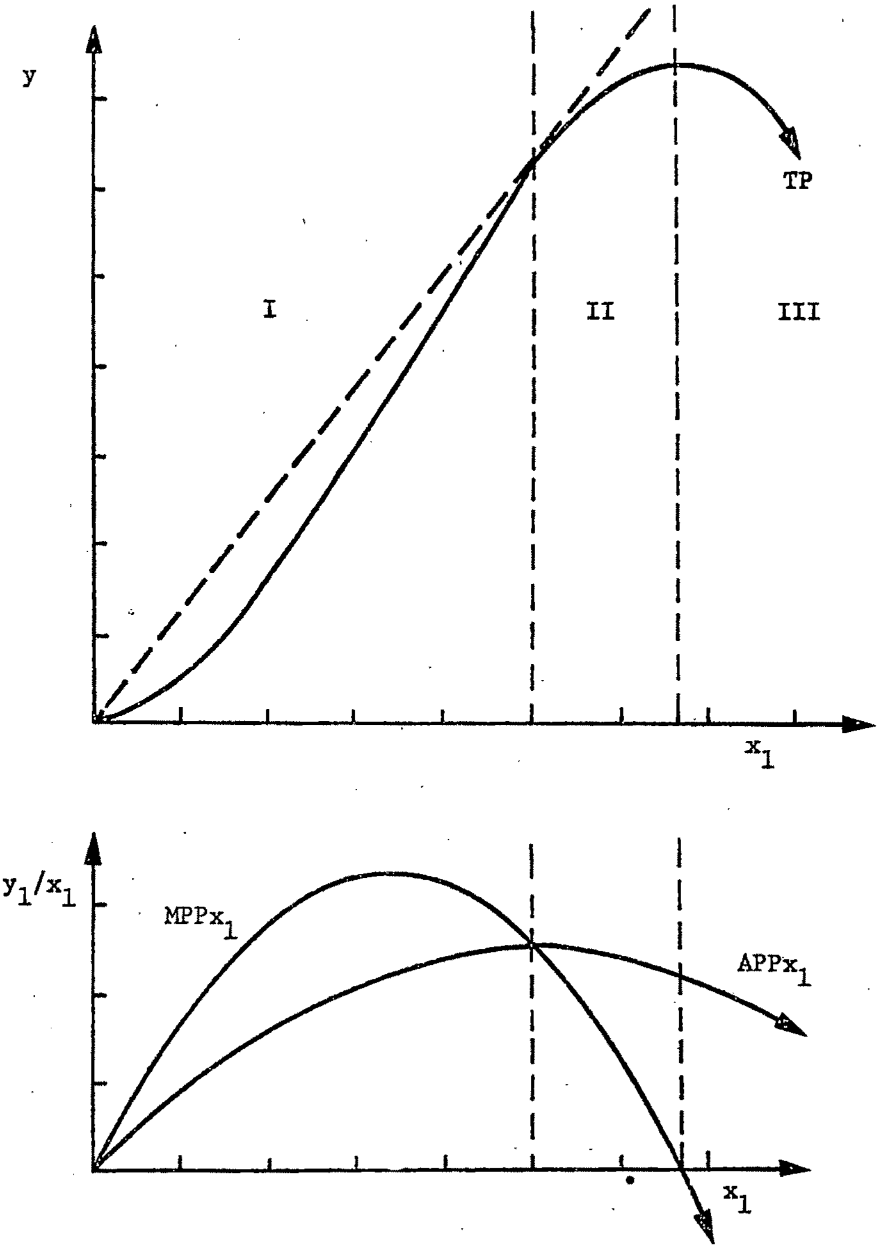

Figure 1. **Relationship between total product, average product, and marginal product based on a cubic production function for one variable input x_1 with all other inputs, $x_2, x_3, \ldots, x_n$ fixed in amount**

The purpose of this paper is to clarify two alternative definitions of uneconomic regions of production and to distinguish between the assumptions used as the basis for these definitions. One definition is based on the assumption of homogeneous production functions with two inputs. This might be called the "traditional" or "physical" or "constant elasticity" definition. The other is the cost-oriented definition used by Hicks [6] and others based only on the assumption of constant prices. The assumption of constant prices is much simpler, especially pedagogically, than that of homogeneity.

A Cost-Oriented Definition

The "intensive margin" of production presents no problem in teaching. A variable factor, x_1, if free, is liberally applied right out to the point where its marginal physical product, $MPPx_1$, is zero. This is the boundary between region II which is rational and region III which is uneconomic for all positive input prices.

It is with the "extensive margin," where the variable factor will be applied in at least a sufficiently high ratio to achieve maximum (or declining) average physical product, $APPx_1$, that problems arise. These problems can be simplified considerably by assuming constant prices and identifying the maximum point of $APPx_1$ with the minimum point of the average variable cost curve (in the single variable factor case).

In Figure 2, it is shown that if it is profitable to use any x_1 it will always be profitable to use x_1, at least to the point where $APPx_1$ is a maximum. This diagram shows total revenue, TR, as a function of one input, x_1. If the price of the product is constant, then TR has the same shape as the total product curve. If the input price is constant, total variable cost, $TVCx_1$, will be a straight line through the origin. The distance between TR and $TVCx_1$ represents net returns over the cost of x_1. Net returns with respect to this input will be maximized where $TVCx_1$ is parallel to TR.

At the price of x_1 represented by $TVCx_1$ in Figure 2, there are no profits. This is the point where $APPx_1$ is a maximum. For any lower price of x_1, a larger quantity of x_1 would be used. If the price of x_1 were higher than that represented by $TVCx_1$, no x_1 would be used. Hence, we can say that if it pays to use any x_1 at all, it pays to use it at or beyond the point where $APPx_1$ is maximum (and hence average variable cost increasing in the single variable input case).

There is no reason why this rule can't be extended to define rational use of each input for functions of more than two inputs. *The economic region of production is defined by a decreasing $APPx_i$ and a positive $MPPx_i$ for each input, x_i, while every other input is assumed to be constant.*

This rule is not limited to the case of two inputs, as are the definitions in terms of homogeneous production functions referred to above. Moreover it corresponds to the third condition of Hicks and Carlson.[4] Hicks' condition that the average cost be increasing is

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[4] There is relatively little confusion concerning the rational region of production in a cost of output context. From a cost of output standpoint, profits in the competitive case are maximized where (1) $MC =$ price, (2) MC is increasing, and (3) average variable cost is increasing. See Friedman [5, pp. 107-111]. The corresponding average and marginal product conditions for inputs are stressed by Hicks [6, pp. 82 and 85] and Carlson [2, p. 100].

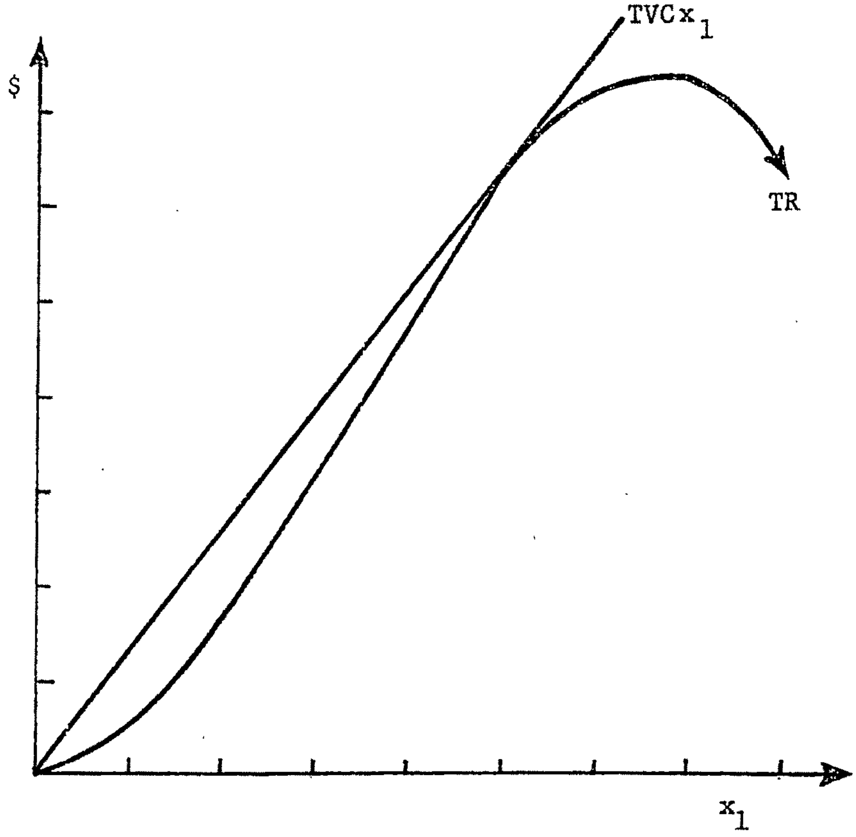

Figure 2. **Total revenue and total variable cost with respect to one variable input illustrating zero returns to the fixed factors,** $x_2, \ldots, x_n$

necessary for profit maximization and applies to any number of variable inputs or joint products. This condition states that a level of production which meets the first and second order conditions must also be superior to any other combination, including no production.

The result is different from that obtained by Mundlak [9].[5] For elasticities of production greater than one, his definition encompasses a larger region of rational production; and it is precisely in this case that his rule suggests that production could take place with *APP* increasing. The Mundlak approach will now be explained a bit more fully and the results compared with the above rule.

The Elasticity of Production Approach

The elasticity of production for a two-factor production function

$$y = f(x_1, x_2),$$

when the quantity of each factor is

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[5] *Op. cit.*, [9, p. 758].

multiplied by a constant m, is given by the formula:

$$(1) \quad e_p = \frac{dy}{my} = \frac{MPPx_1}{APPx_1} + \frac{MPPx_2}{APPx_2}.$$[6]

This definition holds for all production functions, and for any given point on a function, it specifies that

$$\frac{MPPx_1}{APPx_1} = e_p$$

when $MPPx_2 = 0$.

Elasticity less than one

If $e_p = .5$, for example, what can be said about the relationship of $APPx_1$ to $MPPx_1$ at the point where $MPPx_2 = 0$? In this case, it follows from (1) that $APPx_1$ must be twice as large as $MPPx_1$ at this point. Since $MPPx_1$ is less than $APPx_1$, $APPx_1$ is decreasing. This relationship is shown in Figure 3.

Where does region II begin in Figure 3? If one follows the definitions of Mundlak and Bilas, region II begins where $MPPx_2$ becomes positive. Following the cost-oriented rule to produce in the region where the average product of x_1 is decreasing and the marginal product of x_2 is positive also means that one should use x_1 at least up to the point *IB* in Figure 3. If the elasticity of production is less than one, then, the two definitions of region I agree.

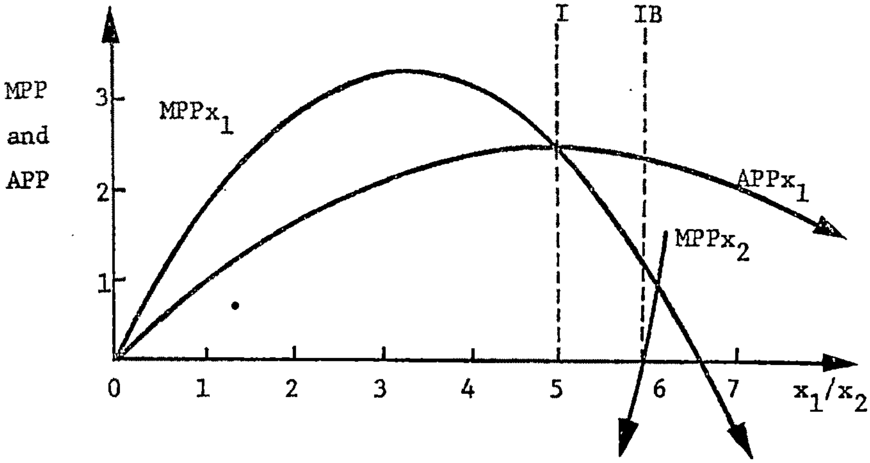

Figure 3. Relationship of $APPx_1$ and $MPPx_1$ when elasticity of production is less than one

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[6] The definition is based only on an assumption of equi-proportional changes in all inputs that change, $dx_1 = mx_1$, $dx_2 = mx_2$, etc., and the mathematical expression for the total differential

$$dy = \frac{\partial y}{\partial x_1} dx_1 + \frac{\partial y}{\partial x_2} dx_2 + \cdots$$

or

$$dy = MPPx_1 mx_1 + MPPx_2 mx_2 + \cdots$$

Dividing by y gives us the proportional change in output and dividing further by m gives us the proportional change in output divided by the assumed scalewise proportional changes in all inputs that change, or the desired definition of elasticity. One convenient test for homogeneity is to show that e_p is a constant.

Elasticity constant and greater than one

If $e_p = 1.5$, then $MPPx_1$ is 1.5 times larger than $APPx_1$ at the point where $MPPx_2 = 0$. Since $MPPx_1$ is greater than $APPx_1$, $APPx_1$ is still increasing. This relationship is shown in Figure 4. In this case, should one define region II to begin at the point where $MPPx_2$ becomes positive, IA, or at the point where $APPx_1$ is maximum and average variable cost is minimum? Production between IA and I would not be economic if the prices of the product and x_1 are constant. It is our contention that it would be sounder economics to teach that the rational region of production begins where $APPx_i$ is maximum and ends where $MPPx_i$ is zero. These conditions must hold for all inputs.

Since $APPx_1$ and AVC are inversely related only in the single variable input case, what can be said when two or more inputs are variable? Whenever input proportions are constant, it is possible to treat all the inputs which change together as one composite input. Statements about elasticity of production greater than one for several inputs can be translated into *APP* increasing (and hence average variable cost decreasing) for the composite input. Starting with two conditions: (1) constant prices and (2) elasticity of production greater than one for all of the inputs which are varied together, profit maximization requires that output be expanded until one of these conditions gives way. Elasticity could become less than 1 (*APP* declining), input prices could increase, or the product price could decrease in order to limit production.[7] Carlson [2, p. 22] stressed this relationship graphically, and McElrow [8] has helped clarify the algebra of elasticity for any symmetric produc-

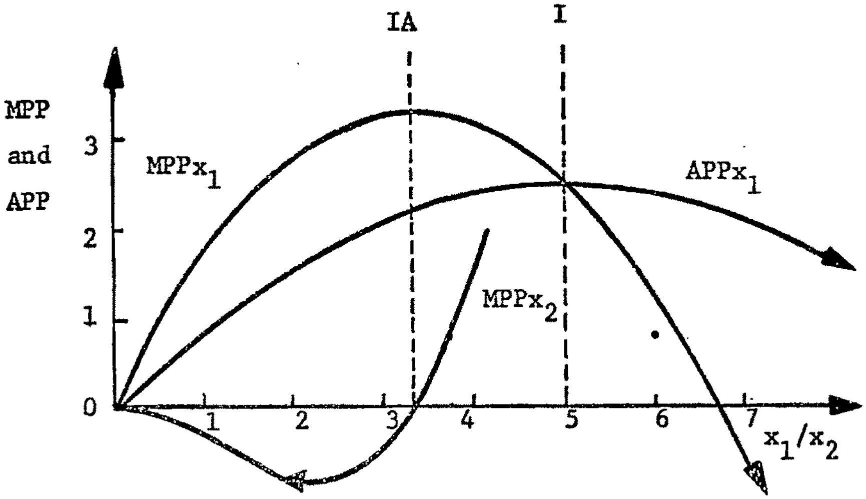

Figure 4. Relationship of $APPx_1$ and $MPPx_1$ when elasticity of production is greater than one

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[7] Actually, the authors feel that costs of transporting inputs or products provide the most plausible upper limits on plant sizes.

tion function. When input proportions are not constant no simple connection between the elasticity of production and cost is possible.

Conclusion

There is something to be said for the esthetic properties of regions I, II, and III as defined in purely physical terms for two input production functions that are homogeneous of degree 1. Mundlak helped clarify this definition of the three regions of production and, at the same time, extended it to functions that are homogeneous of any degree. We have found his note very useful in our teaching.

Still, the authors feel that simplicity of assumptions and the need to think in terms of more than two inputs provide a strong case for a cost-oriented definition of the economic region of production. When input and product prices are positive and constant, region II is defined by $APPx_i$ decreasing and $MPPx_i$ positive. This rule applies to every input and every production function as long as prices are constant.[8] It is an unnecessary distraction to bring homogeneity and symmetry into our textbook discussions of the uneconomic regions of production.

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[8] Both *AJAE* reviewers asked that the discussion be extended to include variable prices. An increasing input supply function for a monopsony or decreasing product demand for a monopoly could cause optimal production to fall within region I as defined above for constant prices. It is much less likely that a decreasing input supply price function such as a rate schedule for an individual firm will cause optimum production to fall within region III.

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ON TESTING COMPETING HYPOTHESES: ECONOMIC RATIONALITY VERSUS TRADITIONAL BEHAVIOR—A FURTHER DEVELOPMENT

At the 1967 Winter Meeting of the American Agricultural Economics Association, we presented a test for profit maximization.[1] We showed that in a profit-maximizing model, under certain assumptions, all pairs of relationships between variable inputs, output, and fixed inputs are linear in the logs. We tested this model for a random sample of owner-operated Greek farms. We found that the microcosm of our sample data is indeed characterized by such linear relationships between every pair of inputs, as well as between each input and output. Can we infer from this test that the entrepreneurs in our sample maximized profits?

Testing is a process of discriminating among competing hypotheses. A test by confirming a hypothesis rejects one or more alternative hypotheses—be it the null hypothesis, a naive hypothesis or a serious alternative hypothesis. In our case, a conceivable null hypothesis is that entrepreneurs behave in an entirely random way. Rejecting this hypothesis is hardly an impressive record for our test, as Professor Johnson justly observed in discussing our paper [5]. Moreover, Johnson suggested that the results of our test, the log-linear relationships between inputs and output, are consistent with the "traditional behavior" hypothesis in which "all Greek farmers were taught as young men to apply so much capital and so much labor per unit of land" [5, p. 398]. Our test, then, does not discriminate between the profit-maximization hypothesis and the "traditional" or fixed-proportions hypothesis.

Our present purpose is to develop the model that involves entrepreneurial profit maximization; to set up a perfectly respectable alternative hypothesis, which does not imply log-linear relationships between inputs and output and which, as a result, is rejected by the test; and to argue that "traditional behavior" as the term is used in the literature, is closer to the alternative hypothesis that we set up than to Johnson's alternative (naive) hypothesis of fixed proportions. In conclusion, we argue that the fact that our test does not discriminate between the profit-maximization hypothesis and Johnson's alternative hypothesis is hardly a defect of the test. Should one also wish to test for the fixed-proportions hypothesis, other tests are available—and the presently existing evidence suggests that the fixed-proportions hypothesis should be rejected for agriculture.

The General Model: Utility Maximization

Consider a general model in which utility is a function of revenues and costs. We call the objective *utility maximization*

$$\max U(R, C)$$

and we further specify the properties

$$\frac{\partial U}{\partial R} > 0 \quad \text{and} \quad \frac{\partial U}{\partial C} < 0.$$

Within this general model, we can specify a family of alternative hypotheses. Let us consider two: H_1, the "profit-maximization" hypothesis, and H_0, the "traditional" hypothesis.

$$H_1: \quad \max U(R, C) = R - C = \pi$$

with the properties

$$\frac{\partial U}{\partial R} = +1 > 0 \quad \text{and} \quad \frac{\partial U}{\partial C} = -1 < 0$$

i.e., constant marginal utility of revenue (or output) and constant marginal disutility of cost. Profit, π, is defined as the difference between revenue and cost.

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[1] The paper has been abstracted in [9].

$$H_0: \quad \max U(R, C) = \log R - C = \tau$$

with the properties

$$\frac{\partial U}{\partial R} = \frac{1}{R} > 0 \quad \text{and} \quad \frac{\partial U}{\partial C} = -1 < 0$$

i.e., diminishing marginal utility of revenue (or output) and constant marginal disutility of cost. We will argue below that a perfectly acceptable definition of traditionalism involves the diminishing marginal utility of revenue as a necessary condition.

We make explicit the general *utility* maximization model by postulating a two-input Cobb-Douglas production function and constant elasticity functions for the supply of inputs and the demand for output.

$$(1) \quad Q_i = A_i f(K_i, L_i) = A_i K_i^{\alpha} L_i^{\beta}$$

$$(2) \quad K_i = k r_i^{\eta} \quad \text{or} \quad r_i = \left[\frac{K_i}{k}\right]^{1/\eta}$$

$$(3) \quad L_i = l w_i^{\epsilon} \quad \text{or} \quad w_i = \left[\frac{L_i}{l}\right]^{1/\epsilon}$$

$$(4) \quad Q_i = q p_i^{-\lambda} \quad \text{or} \quad p_i = \left[\frac{Q_i}{q}\right]^{-1/\lambda}$$

where: Q_i, K_i, and L_i are, respectively, physical output, capital, and labor for firm i; r_i, w_i, and p_i are, respectively, the prices of capital, labor, and output for firm i; A_i is the "efficiency parameter"; α and β are the elasticity coefficients of production and are assumed constant across firms; and η and ϵ are the supply elasticities for capital and labor, respectively, and λ is the demand elasticity for output—also constant across firms. Capital and labor are the two variable inputs of production that are within the control of the entrepreneur. All other factors of production (e.g., land, entrepreneurship, etc.) are lumped with the efficiency parameter and are considered fixed for a firm in the short run.[2]

We define the total revenue from output for firm i and by substitution from (1) and (4), we have

$$(5) \quad R_i = p_i Q_i = A_i' K_i^{\alpha(1-1/\lambda)} L_i^{\beta(1-1/\lambda)}$$

where $A_i' = q^{1/\lambda} A_i^{(1-1/\lambda)}$.

Similarly, we define costs for capital and labor for firm i and by substitution from (2) and (3), we have

$$(6) \quad \begin{aligned} C_k = r_i K_i &= \left[\frac{K_i}{k}\right]^{1/\eta} K_i \\ &= \left[\frac{1}{k}\right]^{1/\eta} K_i^{(1+1/\eta)} \end{aligned}$$

$$(7) \quad \begin{aligned} C_l = w_i L_i &= \left[\frac{L_i}{l}\right]^{1/\epsilon} L_i \\ &= \left[\frac{1}{l}\right]^{1/\epsilon} L_i^{(1+1/\epsilon)}. \end{aligned}$$

Within this general model, we can now distinguish between the two alternative hypotheses, H_1 and H_0.

The Profit-Maximization Model, H_1

We write

$$(8) \quad \begin{aligned} \pi_i &= R_i - r_i K_i - w_i L_i \\ \pi_i &= A_i' K_i^{\alpha(1-1/\lambda)} L_i^{\beta(1-1/\lambda)} \\ &\quad - \left[\frac{1}{k}\right]^{1/\eta} K_i^{(1+1/\eta)} \\ &\quad - \left[\frac{1}{l}\right]^{1/\epsilon} L_i^{(1+1/\epsilon)}. \end{aligned}$$

For profit maximization, we differentiate (8) partially with respect to each variable factor of production and we set $\partial\pi_i/\partial K_i = 0$ and $\partial\pi_i/\partial L_i = 0$. We have

$$\frac{2\pi_i}{\partial K_i} = \alpha\left[1 - \frac{1}{\lambda}\right]\frac{R_i}{K_i} - \left[1 + \frac{1}{\eta}\right] \cdot \left[\frac{1}{k}\right]^{1/\eta} K_i^{1/\eta} = 0$$

or

$$(9) \quad \log R_i = a + \left[1 + \frac{1}{\eta}\right] \log K_i$$

where

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[2] Of course, as the subscript of the efficiency parameter indicates, the fixed factors may vary between firms.

$$a = \log \frac{\left[1 + \frac{1}{\eta}\right]}{\alpha\left[1 - \frac{1}{\lambda}\right]} \left[\frac{1}{k}\right]^{1/\eta}.$$

By symmetry, the maximization condition for labor input yields

$$(10) \quad \log R_i = b + \left[1 + \frac{1}{\epsilon}\right] \log L_i$$

where

$$b = \log \frac{\left[1 + \frac{1}{\epsilon}\right]}{\beta\left[1 - \frac{1}{\lambda}\right]} \left[\frac{1}{l}\right]^{1/\epsilon}.$$

Equations (9) and (10) indicate that in the profit-maximizing model, there is a systematic (linear in the logs) relationship between revenue (or output) and capital and between revenue and labor. The economic interpretation of these relationships is straightforward. Equation (9) describes the maximizing behavior of the firm that controls the quantity of capital it employs but has to take the quantity of labor as constant; and vice versa for labor in equation (10). Each of these conditions, taken by itself, is a necessary but not a sufficient condition for complete profit maximization. The two, taken together, are both necessary and sufficient conditions.[3]

From (9) and (10), we write

$$(11) \quad \log K_i = \frac{b - a}{\left[1 + \frac{1}{\eta}\right]} + \frac{\left[1 + \frac{1}{\epsilon}\right]}{\left[1 + \frac{1}{\eta}\right]} \log L_i.$$

This result indicates that in the profit-maximizing model, there is a systematic relationship between the quantity of capital and the quantity of labor employed.[4]

One can test to find out whether relationships (9), (10), and (11) are satisfied. We may illustrate how one can draw conclusions about profit maximization with reference to equation (11). In the case of perfect profit maximization with no random disturbances superimposed upon the systematic terms, the coefficient of correlation between the two variable inputs should tend to one. On the other extreme, if the systematic behavior dictated by profit maximization is entirely absent, only random disturbances would account for any relationship between capital and labor that might be observed, and the coefficient of correlation between the two inputs should approach zero.[5] Correlation close to one, then, confirms the hypothesis of profit maximization. Correlation close to zero rejects the hypothesis of profit maximization and confirms the hypothesis of random entrepreneurial behavior.

Suppose that the test reveals correlation close to one. The profit-maximization hypothesis is confirmed, but only in comparison to the random behavior hypothesis—an extremely naive hypothesis which is a sure loser. Is the victory of H_1 a Pyrrhic victory? It turns out that a more serious competitor, an entirely plausible alternative hypothesis, can be formulated and can be rejected by the results of a test that confirms H_1. This is the purpose of the next section.

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[3] Formally, there is also a third partial condition for profit maximization—the factor-proportions condition. It refers to the firm that controls *both* capital and labor and has to achieve a specified level of output (irrespective of whether the scale of output is correct or not). This condition is described by equation (11).

[4] In the complete version of the paper, we also show that profit-maximizing output, capital, and labor are all log-linear functions of the exogenous efficiency parameter representing the fixed inputs of production (land, entrepreneurship, etc.), i.e., of A'_i in the above notation. As a result, firms that maximize profits do not all need to have the same factor proportions. See [8].

[5] The rigorous proof of this statement is provided in the complete paper. See [8].

The "Traditional" Model, H_0

We write

$$\tau_i = \log R_i - r_i K_i - w_i L_i$$

$$\tau_i = \log A_i' + \alpha\left[1 - \frac{1}{\lambda}\right] \log K_i + \beta\left[1 - \frac{1}{\lambda}\right] \log L_i - \left[\frac{1}{k}\right]^{1/\eta} K_i^{(1+1/\eta)} - \left[\frac{1}{l}\right]^{1/\epsilon} L_i^{(1+1/\epsilon)} = W(K_i, L_i). \tag{12}$$

We differentiate partially with respect to capital and labor, setting the first derivatives equal to zero. We have

$$\frac{\partial W}{\partial K_i} = \alpha\left[1 - \frac{1}{\lambda}\right]\frac{1}{K_i} - \left[1 + \frac{1}{\eta}\right]\left[\frac{1}{k}\right]^{1/\eta} K_i^{1/\eta} = 0$$

or

$$K_i = \left\{\alpha \frac{\left[1 - \frac{1}{\lambda}\right]}{\left[1 + \frac{1}{\eta}\right]} k^{1/\eta}\right\}^{(1/(1+1/\eta))}$$

$$\log K_i = \frac{1}{\left[1 + \frac{1}{\eta}\right]} + \log \alpha \frac{\left[1 - \frac{1}{\lambda}\right]}{\left[1 + \frac{1}{\eta}\right]} k^{1/\eta}. \tag{13}$$

By symmetry, the maximization condition for labor input yields

$$L_i = \left\{\beta \frac{\left[1 - \frac{1}{\lambda}\right]}{\left[1 + \frac{1}{\epsilon}\right]} l^{1/\epsilon}\right\}^{(1/(1+1/\epsilon))}$$

$$\log L_i = \frac{1}{\left[1 + \frac{1}{\epsilon}\right]} + \log \beta \frac{\left[1 - \frac{1}{\lambda}\right]}{\left[1 + \frac{1}{\epsilon}\right]} l^{1/\epsilon}. \tag{14}$$

This result indicates that in this "traditional" model, the systematic part of capital inputs does not vary with the systematic part of labor inputs, i.e., both are constant.[6] The variation, then, in each input is due entirely to random disturbances. As a result, we would expect the correlation between capital and labor to be rather small—in the extreme case, this correlation would approach zero. If, then, by fitting equation (11) we find correlation between capital and labor that tends to one, we conclude, not only that H_1 is confirmed, but also that H_0, this "traditional" hypothesis, is rejected.

Which "Traditional" Model?

We have, then, two "traditional" models, one suggested by us, which has been rejected by the finding of strong correlation between the logs of capital and labor, and one suggested by Johnson which is consistent with that finding. The purpose of this section is to argue that Johnson's hypothesis is weaker than the profit-maximization hypothesis, which is also consistent with the test; in fact, it can be rejected on the basis of prior information about agriculture. We also suggest that Johnson's model is a "pseudotraditional" model that is inconsistent with the concept of traditionnalism, as used in the literature.

Two are the characteristics of Johnson's traditional model: that knowledge has been handed down from father to son; and that this knowledge consists of fixed proportions. The way the knowedge is disseminated is surely an irrelevant criterion for characterizing economic behavior. Had the fathers taught their sons to maximize profit instead, this would not have made the profit-maximization model a traditional model. The fixed proportions characteristic of Johnson's model, on the other hand, is inconsistent with *a priori* information about agriculture. Fixed proportions implies zero elasticity of substitution. Although still sparse, the evidence presently available suggests that the elasticity of substitution in agriculture is consistently higher than one (1.2 is the modal coefficient given) [1, p. 240; 4, p. 963]. Furthermore, fixed proportions is a characteristic that is contrary to at least one formulation of the traditional model as it appears in the literature. The approach of technical dualism requires that the traditional sector displays variable technical coefficients of production; hence, it is able to absorb varying labor input. This is how the traditional sector becomes increasingly labor intensive as population increases between the fathers' and the sons' generation [3].

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[6] From footnote 3, it also follows that capital and labor are constant functions of A'_i, the exogenous efficiency parameter.

In a recent article in this *Journal*, Marvin P. Miracle [6] has compiled a list of the criteria that are used in the literature, alone or in combination, to describe tradition (or subsistence) agriculture. They are: (a) "low" level of consumption, (b) "small" (or zero) proportion of production marketed, (c) "perverse" motivations to produce, and (d) slow rate of change of techniques of production. While Johnson's traditional model satisfies none of these criteria, our alternative traditional hypothesis is consistent with at least criteria (b) and (c).

The extreme case of variant (b) of traditionalism is that the economic units (family, in our case) are "... self-sufficient, producing only what they require for their own consumption, and having little or no systematic exchange relationship among each other" [7, pp. 43–44]. Lack of marketization implies that the marginal utility of own production declines rapidly with the marginal utility of own consumption. This diminishing marginal utility of production is the characteristic of our traditional model. Variant (c) of traditionalism emphasizes the "limited needs" of the economic unit[7] that curtail its motivations to produce. Limited needs also implies that the marginal utility of own production starts declining at an early stage. This variant is then also consistent with our traditional model.

Summary

A testable and empirical implication of a model in which farmers maximize profits is the existence of a log-linear relationship between the quantity of capital and the quantity of labor employed. This implication is inconsistent with the model in which farmers behave randomly. But most important, it is also inconsistent with a "traditional" model that is characterized by diminishing marginal utility of own production. Therefore, by confirming the profit-maximization hypothesis, we reject this traditional hypothesis.

The same empirical implication of the profit-maximization model is also consistent with the "pseudotraditional" model of fixed proportions. While the test that is built on the log-linear relationship between capital and labor is not sufficient to differentiate between the profit-maximization hypothesis and the "pseudotraditional" hypothesis, this is hardly a defect of the test. One can devise a good number of other alternative hypotheses that the test (*any* test, for that matter) cannot reject. However, one need not stop at this point in discriminating between the profit-maximizing and the "pseudotraditional" model. Auxiliary criteria, such as consistency with *a priori* knowledge about agriculture, can be used. And the presently available prior information is inconsistent with the fixed-proportions hypothesis.

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[7] For an example of this variant, see [2].

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ON TESTING COMPETING HYPOTHESES: ECONOMIC RATIONALITY VERSUS TRADITIONAL BEHAVIOR: REPLY

Professors Yotopoulos and Wise apparently agree with my earlier statement that their proposed test cannot distinguish between entrepreneurial behavior in a Cobb Douglas world and a fixed proportions world. In fact, they agree that any number of alternative behavioral specifications are consistent with their test. The purpose of a test is to discriminate among alternatives. In their original paper, they stressed the generality of their test. They now assert that the lack of discriminatory power in their test is no defect of the test. The logic of this assertion escapes me.

As I understand their original intent, it was to demonstrate that Greek peasant farmers are "rational," meaning they are profit maximizers. My misgivings with their treatment were in two categories. I could not find the rationale for a crucial assumption that allowed them to define a correlation coefficient as their rationality index. This problem I considered to be secondary to the basic problem that their proposed rationality index was also consistent with a fixed proportions model that does not contain profit maximizing behavior.

I interpret their current statement as postulating a new behavioral model, as they do not like the one I used. The dislike is understandable; I do not like it either, as a description of real world behavior. I did not then, have not since, and never will offer it as such a description. To show the ambiguity in their index, I thought only one counter example was needed. Fixed proportions as a production technique is a widely used analytical device, and as such, it seemed like a useful counter example. I believe my original reasoning is still valid. As long as behavior other than profit maximizing is consistent with their test, the identification of the test as one of rationality is subject to question.

Their new "traditional" model is a strange one, to say the least. They want farmers to maximize a utility function, $U = \log R - C$. For any plausible values of total revenue and total cost, the value of U is negative for this definition. As shown by their definitions, the marginal disutility of cost is always greater than the marginal utility of revenue, for plausible values again. I do not believe this specification can be taken too seriously as a "perfectly respectable" hypothesis, even if it does imply small correlation between a log of capital and the log of labor.

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ON TESTING COMPETING HYPOTHESES: ECONOMIC RATIONALITY VERSUS TRADITIONAL BEHAVIOR: REJOINDER

Professor Johnson, in his original discussion, raised two points: First, our definition of the "rationality index"—he considers it secondary and we agree. Moreover, we view this as a problem not sufficiently general and interesting to inflict upon the readership of this *Journal*, especially since it has been dealt with elsewhere. Second, a methodological problem—this is a point which is self-contained, almost entirely independent of our original paper, and also felicitous. He pointed out that testing is not only a process of matching hypotheses to the facts but also a process of discriminating among competing hypotheses. We had in competition three alternative hypotheses: profit-maximization, fixed-proportions, and random behavior. Our test rejected only the last one. Was that worth the effort?

The question that he posed was challenging. And we accepted the challenge. We formulated a perfectly respectable traditional hypothesis that has received currency in the literature. We consider it a true rival hypothesis, both to the profit-maximization and to the fixed-proportions hypotheses. Our test discriminates against this traditional hypothesis.

Up to this point, our disagreement with Johnson is whether our hypothesis is "strange" or not. In terms of the criteria set up in the literature, we have argued that it is not strange. The criterion advanced by Johnson (the value of U for "plausible" values of R and C) escapes us. Units are arbitrary and our results do not change if we specified the model instead as $U(R,C) = \log(aR) - (aC) = \log a + \log R - aC$. The important characteristic is that our model has a maximizing equilibrium: for, $0<R<1$, $\partial U/\partial R > -\partial U/\partial C$.

We do disagree, nevertheless, with the new methodological point that Johnson raises in his Reply: that a decent test is supposed to discriminate against all *but* one hypothesis. This is obviously impossible, since there exist an infinite number of alternative specifications that can be formulated so as to fit any set of observations; it takes only a polynomial with the turning points at the right places.

Still, however, the sifting and winnowing of competing hypotheses need not end with the results of any single test. More tests may further narrow the set of acceptable hypotheses. Also, as a last resort, the literature on economic methodology suggests auxiliary criteria for ranking hypotheses which are all consistent with the facts: the realism of the assumptions; the simplicity, fruitfulness, and elegance of the hypothesis; its consistency with other theory; etc. Our statement suggests that the fixed-proportions hypothesis could be rejected on the basis of other tests, as well as of one or more of these auxiliary criteria. And our conclusion is that the profit-maximization hypothesis does better on the basis of the presently available stock of facts and alternative hypotheses.

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JOHN WISE

TRAINING FOREIGN GRADUATE STUDENTS IN AGRICULTURAL ECONOMICS: COMMENT

Professor A. B. Lewis [1] has written a very stimulating, constructive, and well documented paper on the increasingly important problem of providing *pertinent* and *useful* graduate level training to students from developing regions. The paper should provoke reactions from agricultural economists in "traditional countries."

Although I am in general agreement with the author's fundamental theory and aware that he states his argument primarily with reference to students from Asia and Africa attending United States universities, still there are two aspects of his paper about which I would like to comment, as they may relate to students from Latin America.

Lewis delves into philosophical and cultural traits to explain in detail and to show the professional limitations of students from developing regions attending American universities to do abstract thinking, as compared with American students. These limitations arise in Lewis' opinion "out of differences in habits of thought and views of reality, and out of differences in their concepts of human relationships and the functions and responsibilities of the scholar, the official, and the economic leader" [1, p. 685]. The author contends that the root of the problem lies in the difference between a "Greek" and a "non-Greek" mind.

Is the philosophical legacy of the Latin American student in United States universities "non-Greek"? Professor Lewis says yes. I believe Latin America is part of the Western world. As such, the "Greek mind" is part of our tradition and should be part of the Latin American way of thinking. Yet, I find some, but not all, of Lewis' characteristics of traditional agricultural civilizations applicable to students from the region. The Latin American student is strongly inclined to the literary style and to dialectics; and he tends to appraise problems and situations too subjectively. I cannot but agree heartily with the author when he talks about the "once and for all" remedies to all of our maladies and tribulations that are concocted by political leaders and scholars. In Latin America we have had, to name a few, industrialization, land reform, and, more recently, a Latin American Common Market. This last with the prodding, assistance, and support of United States leaders!

Why is this so? Perhaps the causes of these traits are to be found in institutional factors along with other influences of the "Latin endowment."

Not saying that he intended to imply a priority, Lewis lists and discusses nine quite orthodox course categories—farm management, marketing, farm finance, cooperation, land economics, agricultural prices, etc. These suggestions reveal his wide experience with problems and conditions in "traditional countries." My differences with Professor Lewis on his list are not so much of substance as of emphasis and omission.

Of the subjects listed, I would place agricultural prices last. Such a course, although important and necessary for a graduate student, does not have the utility in my part of the underdeveloped world that it may have elsewhere. Besides, the refinement and sophistication required to build price indexes and the lack of statistical series that are hard to find, preclude the construction and application of such planning and development aids for some time in the future.

I fully agree with Lewis' statement that farm management "is the most vital subject for foreign students to master because it is a necessary foundation for all economic judgments affecting both individual farm operations and the entire farming sector." He further adds that this course, when taught to foreign students, should not be done mechanically or superficially but that the reasons and the depths of it ought to be explored and explained. Lewis could have added for emphasis that our concept of a farm is clouded by the tens of thousands of small subsistence farms with the familiar characteristics of low productivity, inefficient resource use and "traditional" production methods. Understandably, when faced with the task of budgeting an American farm as part of a farm management course, we are literally at a loss on how to proceed. This kind of training, as it is usually offered, is of limited value. Further, few of us have had equal or even similar experiences in our countries. Farms, large or small, have different crops and different enterprise combinations; levels and utilization of technology and entrepreneurial attitudes and values also differ.

To Professor Lewis' list of desirable courses for students from underdeveloped areas, I would like to add logic, agricultural policy, and research training. If the Latin American student lacks a "Greek mind," the enumeration by Professor Lewis of what has been inherited from Greek thinkers logically leads us to consider logic a needed course for students from developing countries. Most of the students from traditional countries, when they return to their homeland, occupy positions from which they can either formulate or influence policy. Very few Latin American countries have an articulate, clearly defined and stated policy in agriculture. Students should be exposed to the philosophy and practical difficulties and limitations of policy. Such a course lends itself admirably to impressing upon the foreign student the futility of pursuing panaceas.

I am sure Professor Lewis is well aware that research is one of the most rewarding activities most returning graduate students have to perform. He is also keenly aware of the need for research in order to provide information and guidelines for formulating policy and planning the development of agriculture. This aspect, training in research, its theoretical, philosophical, and empirical conception and application, is one in which United States universities could make a significant contribution to developing regions. The student needs to learn how to integrate theory with reality. He needs to be trained to recognize the problem at hand; to state it clearly and precisely; to limit the scope of the study; to "see" and discover the implications and projections of the data he gathers; and to give the collected data a realistic and comprehensive analysis and interpretation. Because of inadequate training in research for conditions prevalent in developing regions, a good number of research reports by Latin American students with postgraduate training lack the scientific rigor they could have and, thus, the usefulness that the region so urgently needs.

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[1] LEWIS, A. B. "Training Foreign Graduate Students in Agricultural Economics," *J. Farm Econ.* 49:684–704, Aug. 1967.

Reviews are listed alphabetically by authors.

Reviews

Buchanan, James M., *The Demand and Supply of Public Goods*, Chicago, Rand McNally and Company, 1968, ix + 214 pp. ($5.00)

During the last quarter of this century, as the exigencies of military preparedness and economic development increased the economic importance of the public sector in both developed and less developed nations, and as a new affluence in advanced countries allowed the luxury of thinking about human welfare and the quality of life, economists finally began to invest a good portion of their energies on problems not readily answerable in the terms of Marshallian diagrams or Keynesian graphics. James M. Buchanan's theoretical treatise on the supply and demand of public goods is both evidence of and an integral part of these new investments of our profession. It is an important book; more, however, for the profoundness of the questions it raises than for those it lays to rest. Building upon, as well as synthesizing in a unique way, the works of such Engish speaking scholars as R. A. Musgrave, Paul Samuelson, and J. G. Head, Buchanan develops the foundation for a new approach to public finance. Critical of the fact that in the past the theory of public finance has treated government as an exogenous factor "wholly apart from their citizens" and has limited its concerns to the problem of how to most effectively cater to governmental needs for resources, Buchanan sketches a new course for this subdiscipline of economics. He wishes to see a theory of public finance that yields both positive and normative insights into the demand for and the supply of public goods and the institutional foundations necessary for the proper and adequate expression of this demand and supply. His book is an attempt to begin the structure of such a theory.

Professor Buchanan's approach to model building is standard. Assuming away all the complexities of reality, he constructs a humorous and informative simple exchange model, "one in which there are only two persons (perfect equals) and two goods, one public and one private." He established the conditions for equilibrium in this model with ease. In fact, he does it in three different ways: a modified Edgeworth diagram, an algebraic formulation and Marshallian geometry. But as soon as he complicates his model through relaxation of his assumptions, he moves rapidly towards a world of difficulty founded on, all too often, completely elusive equilibrium conditions. And herein lies the major weakness of the book.

The complexity and uncertainty of the deductions obtained from his models may be indicative of the shortcomings of the methodology he follows. Though he wishes to move beyond the simple application of Marshallian based systems, he ties himself to the methods of standard economic analysis. He still employs the comfortable apparatus of assumptions, equations, and deductions which, unfortunately, are ultimately more revealing of the importance of omitted variables than of the variables included. Professor Buchanan might have been better off asking if perhaps the questions raised by the desire for public goods are intractable when approached in terms of indifference maps and the avoidance of interpersonal comparisons this methodology demands. What is necessary is a broader approach to the subjects of institutional arrangements and value systems than mathematical systems seem to allow us to follow.

Buchanan's theoretical models are not difficult and are well worth working through. But it is when Buchanan departs from the world of curves and formulas that the reader receives his greatest value. His discussion of the "free rider problem"—individuals who, when they apply the logic of maximization of expected values, receive the benefit of public goods without sharing the cost incurred in their supply should be exceptionally interesting to all concerned with the problem and benefits of social insurance. And his discussions of: the organization of institutional arrangements; the enforcements of necessary patterns of behavior; unanimity rules; rules for reaching group decisions; institutions of fiscal choice; which goods should be public and which private; cause the reader to reflect not only upon the daily headlines but upon the foundations of our discipline and those of social science.

For those who have not followed the literature in this field or have not done so with maximum efficiency, Buchanan supplies excellent bibliographical information at the conclusion of most chapters. This is an important element in the book, for it is difficult to visualize a concerned reader who will not wish to delve more deeply into the literature.

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Burk, Marguerite C., ***Consumption Economics: A Multidisciplinary Approach,*** **New York, John Wiley & Sons Inc., 1968, xvii + 359 pp. ($9.95)**

One would almost have to agree with Dr. Burk that "the chaotic combination of masses of data, many problems, and relatively little economic theory has made the field of consumption economics appear far more diffuse and insignificant than its rapid development and substantial contributions to agriculture, business and government policy and program determination merit." With breadth of purpose, meticulous attention to detail and a meritorius attempt to show interrelationships between economics and related fields such as marketing, psychology, social-psychology, and others, Professor Burk has done great service; however, the book leaves the impression that the author still is not clearly delineating the field from, say, marketing on the one hand and welfare economics on the other. In spite of this, the book is a very substantial contribution which should be especially useful as supplementary or prime text material in Food Economics, Agricultural Policy, Price Analysis, Marketing, and related courses, as well as in Consumption Economics courses *per se*, at the upper division and beginning graduate levels.

Professor Burke devotes the first part of her book to a discussion of "What is Consumption Economics." In the four chapters making up this section, she tackles with vigor the scope and content of consumption economics and the role of consumption in a market economy, as well as an historical view of levels of consumption in the U.S. and consumption in less-developed countries. In this, Professor Burk seems to have a hard time positioning herself in relation to her readers; it seems as if she is alternately writing for students (as professed in her prefatory comments), practitioners such as marketing personnel, and fellow academicians. Thus, it is hard to know from what vantage point to react or evaluate. Also, the level of complexity seems to vary—for instance, she drops in a concept such as comparative advantage quite cavalierly while seeming to start nearly from scratch in development of other economic concepts, assuming little by way of reader cognizance. While some authorities on economic development might feel she over-simplifies problems of development, it seems to me she threads through the discussion of consumption in less-developed countries (Chapter 4) insights of great depth and crucial relevance and, furthermore, couches them in direct, penetrating terms. Less conclusive, in this reviewer's mind, is her delineation of the field of consumption economics. And, although her concern for greater collaboration among economists and other social scientists seems well grounded, it may be that she belabors this point in her discussion of elementary concepts from the various social sciences as if social scientists had no acquaintance beyond their own discipline. Getting them (us!) to actively engage in cross-disciplinary activities is another matter, but some acquaintance with elementary principles of various social sciences might logically be assumed.

Part II Professor Burk devotes to the microeconomics of consumption. Chapter 5, "Marketing and Behavioral Science Approaches to Study of Consumer Behavior," is a useful and succinct review of psychological, sociological, and anthropological concepts having meaning for understanding consumption. In Chapter 6, "Elementary Economic Theory Relative to Consumer Behavior," she makes serious . . . and probably viable . . . accusations against economists for their over-simplifications; yet, she, too, seems to slip into their habits . . . she omits explicit reference to time periods when discussing the concept of utility, for example. In other chapters, most particularly in Chapter 10, in proposing a conceptual framework for the analysis of the micro structure of consumption, it strikes me that Dr. Burk makes a useful contribution; but at the same time

I wish she would have more fully integrated the concepts she is attempting to synthesize (either from the student's, practioner's, or academician's point of view).

Professor Burk deals with the macroeconomics o consumption in Part III. This section is useful, but seems uneven in its treatment, especially Chapter 16. In this section, her economics might be criticized where she confuses variable proportions with returns to scale [p. 225]. More minor criticisms are her uses of terms such as frequency distributions, continuous variables, and others, without explanation, which might cause student hang-ups, especially for undergraduates. Also, Dr. Burk, along with many others, errs in constantly referring to "the war" as a time benchmark . . . most students who are likely to use this book would have been born during or after the Korean conflict and would have matured during the Vietnam holocaust and, therefore, could hardly place World War II as "the war."

Throughout, and with some validity because of the greater abundance of data, Dr. Burk leans heavily toward agricultural examples.

Her two appendices appear to be extremely useful to researchers, both seasoned and beginning. Probably they would be relatively little used by the general student, especially undergraduate. Her usual completeness is shown by inclusion of a sectioned bibliography and both a name index and an unusually good and detailed subject index.

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Collins, Norman R., and Lee E. Preston, *Concentration and Price-Cost Margins in Manufacturing Industries*, Berkeley, University of California Press, 1968, 163 pp. ($5.75)

Students of applied economics will find in this book an excellent model for research procedure and reporting. The analysis utilizes previous research, carefully analyzes new data in light of economic theory, integrates the previous results with the new findings, and reports the conclusions in a concise and highly readable form.

The purpose and scope of the study can best be illustrated by quoting the hypothesis under examination: "Interindustry differences in the relationship between revenues and costs will be positively associated with the degree of oligopoly, as reflected in a concentration index, when differences in capital requirements and the relative importance of regional versus national markets are taken into account" [p. 12]. The primary focus is clearly on the relationship of profits to concentration, with geographic dispersion and capital introduced only because they are important intervening variables.

Collins and Preston begin their empirical investigation with a thorough review of the literature, including recalculation of relationships reported in earlier studies to make them comparable with the approach used in this study. Previous studies include those by Bain, Levinson, Fuchs, Weiss, Schwartzman, Stigler, and Sherman. Twenty two-digit (SIC classification) major manufacturing industry groups are then analyzed using Census data. A price-cost margin variable is defined as the difference between gross revenues and direct costs expressed as a percentage of gross revenues. This profit measure, along with the more typical measures, is then related to the degree of concentration. Since the several profit variables are highly correlated and yield similar statistical results, a theoretical preference for the price-cost margin variable is decisive in its being chosen for the more detailed investigation of the four-digit industries. Next, 288 of the 4-digit industries are examined, with 213 classified into ten industry groups for detailed study. For six of the ten groups, a statistically significant relationship exists between concentration and margin. Of the other four industry groups, the sign is usually correct but the coefficient is not statistically significant at the usual probability levels.

The results are consistent with earlier studies in indicating a positive relationship between concentration and profits. The indicated relationship is linear and continuous rather than kinked at any particular level of concentration. Yet, the relationship is far from exact, suggesting that other variables are of substantial importance in explaining price-cost margins. Several of these variables are discussed in the concluding chapter.

Several remarks might be made concerning the statistical procedures. The construction of the geographic dispersion variable is described but no justification is given for expecting a linear relationship between a constructed index of geographic dispersions and the price-cost margin. Admittedly, there is little basis for specifying any relationship other than a linear one. But, careful examination of the residuals plotted against the geographic dispersion index might suggest a functional form different from the linear form. Alternatively, one might search for a more meaningful measure of dispersion, one that might be related in a nearly linear fashion to price-cost margins. Similarly, data problems plague the estimation of a coefficient for the capital-output ratio. The ratio of book value of assets to value of shipments was used. Obviously, there is a sizeable measurement error in using this ratio as a valid indicator of the importance of capital in contributing to the price-cost margin. Such measurement errors bias toward zero the associated coefficient and reduce R^2 but probably do not seriously affect the regression coefficient associated with the concentration variable.

One would hope for a discussion of the relationship between *changes* in concentration and *changes* in profit margins. This relationship would be more meaningful in policy context where one is attempting to control concentration. In other words, to what extent are the relationships which emerge from a cross-section study appropriate in predicting dynamic changes within an industry? The authors are careful to say "*If* our cross sectional results can be projected into a time dimension . . ." [p. 115, emphasis added]. Users of their results should ask themselves about the reasonableness of this "if" statement. Those who reject the "if" statement are challenged to construct a dynamic model that will be useful in a policy context. Construction of such a model will be difficult because of the large number of intervening variables that merit consideration.

There are surprisingly few misprints but some readers may be confused on p. 78 where the signs of residuals are reversed in the text.

Collins and Preston have produced an excellent study. Their work presents a challenge to those who disagree to produce a more convincing argument.

LESTER V. MANDERSCHEID
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Dubov, Irving, ed., *Contemporary Agricultural Marketing*, Knoxville, The University of Tennessee Press, 1968, x + 270 pp. ($5.95)

This book is a collection of papers presented at the Marketing Section sessions of the Sixty-first Annual Convention of the Association of Southern Agricultural Workers in 1964. It consists of 15 papers and 12 discussions. I frankly do not know how to review the book. It is rather like being asked to review half of the proceedings issues of one of the recent annual meetings of the Association. When I discovered what I had accepted as an assignment—which was, of course, not evident from the title of the book—I felt put upon. But I shouldn't have. I found most of the papers interesting and/or instructive. If these papers are representative of the usual offerings at this conference, then I am put out for never being invited. It is evident the marketing economists of the South are concerned with the same issues as marketing economists in the rest of the country. Except for a tendency to select cotton and citrus as examples, the book shows little regional emphasis. I was, in fact, disappointed to learn so little of the specific issues related to the South. Of course, the title is misleading, for it implies a more comprehensive treatment than is delivered. A discussion of some issues in contemporary agricultural marketing economics is more descriptive of the content.

Let me briefly identify the content of the book. Part I is called "Background Issues." W. B. Back discusses "Relevant Questions for Agricultural Economics Research." He is concerned with the relevance of our research. His test of research results is the degree to which they provide perceptions of the future, especially as related to estimating the economic consequences of alternative programs, policies, or institutions. He wants more macro emphasis. His heart seems to be in the right place. H. F. Breimyer presents some interesting insights on the relationship of policy and entrepreneurial freedom in agriculture. W. W. McPherson tells us of institutional factors in economic development, with most of the emphasis on a comparison of U.S. and Latin America. I believe he is looking in the right place but is required to deal too briefly with a complex topic.

Part II is labeled "Emerging Problem Areas" and might better be "'Some things we have been thinking about lately." J. L. Knetsch talks of research on marketing recreational services which are natural resource based. I was especially pleased that he did not identify user studies of a zero priced service as studies of demand as has so often been implied. B. T. Lanham discusses his paper. M. L. Fowler analyzes problems of the price support program in cotton. He is appropriately concerned with the effect of policies designed to exploit situations where supply and demand are inelastic in the short run and much more elastic in the longer run. Neither Fowler nor his discussant, R. F. Anderson, deals with the problems of large number of people losing a means of support through the effects of technology and government programs in cotton.

E. D. Smith has a paper on the procedural problems of farmer cooperatives, which is discussed by J. M. Law. Smith seems to argue that until a variety of internal procedural problems of cooperatives are solved, voluntary groups are not likely to be effective in achieving market advantage for farmers.

I suppose no conference of this type would be complete without a paper on coordinating research and extension. J. C. Williamson provides a better-than-average contribution on this topic by emphasizing the truth of Adam Smith's observations of the advantage of specialization and coordination. A. D. Seale, in his discussion, reminds us that the Southern Marketing Research Committee developed a framework statement presenting a unified approach to coordination of marketing extension and research.

A. W. Woodard deals with extension assistance to processing firms in evaluation of alternative investment opportunities, and D. G. Dalrymple adds to the paper in his discussion. W. F. Williams has an insightful paper on market structure research, and P. E. Nelson deals with the relationship of macro-micro or firm management-market structure research. The problems raised by these papers are important ones. These papers are discussed by W. R. Henry and S. P. Parry.

Part III is called "Methodological Developments." The papers are fairly technical and empirical. They illustrate the application of several significant quantitative techniques to problems which are generally not trivial. The following papers and discussions are included:

An Analytical and Operational Framework for Solving Problems of Plant Location, by L. Polopolus; discussed by J. M. Stepp.

Use of Linear Programming for Obtaining Minimum Absolute-Deviation Estimates of Functional Relationships, by J. Havlicek, Jr.; discussed by T. E. Tramel.

Decision-Making Models: Methodology and an Application to the Poultry Industry, by J. R. Tedford; discussed by V. G. Hurt.

Generalized Distribution Problem: Framework and Application, by R. L. Feltner and D. D. Rohdy; discussed by B. R. Hoffnar.

Predicting Yields by Objective Counts and Measurements, by W. E. Kibler; discussed by M. R. Langham.

This is not a great book. It is a collection of well done conference papers. I believe graduate students, teachers, and researchers in agricultural marketing will find at least parts of the book useful, depending upon their interests. I am favorably disposed to printing conference papers which meet the quality standards represented in this collection.

JAMES D. SHAFFER
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Gray, James R., *Ranch Economics*, Ames, Iowa State University Press, 1968, viii + 522 pp. ($15.95)

"Way-of-life" ranching is being replaced by sophisticated computerized management of modern ranches. This transition requires that ranchers become more knowledgeable in economic theory. On the other hand, the author contends that economists generally lack knowledge of the pecularities of the ranching business. This book is designed to bridge the gap between ranchers and economists.

Chapters 1, 2, and 8 relate the development of ranching and briefly recount the political, social, physical, and economic circumstances that molded the ranch industry of the western United States. An elaborate discussion of resources and practices commonly found in six U.S. and four foreign production regions is given in Chapter 2. Gray failed to develop in any depth the competitive position of western producers except to note that costs of production were lower than those reported in Ohio and Indiana (Figure 4.4, page 112). Chapter 8 is perhaps the most interesting for those unfamiliar with management problems involving public and private land ownership. Attainment of adequate rangeland with a proper seasonal balance is concluded to be the major task facing ranchers. Differing goals held by ranchers and public agencies compound this problem. The always controversial grazing fee issue is discussed in this section. Material in Chapter 8 provides background information for much of the discussion about conservation in Chapter 10.

The remaining chapters are not dissimilar from what one finds in most farm management texts. Chapters 3, 4, and 5 discuss principles involved in firm decision making, record keeping, and analysis of financial and physical data.

The chapter on capital and credit is largely descriptive. Inadequate treatment is given to the future capital structure of ranches or the problem of redundant capital in the industry. Chapter 7 discusses the legal aspects of ranching and of necessity, it simply illustrates numerous areas of concern to ranchers.

A great deal of work has been done by economists on various range improvement practices. Chapter 11 contains voluminous results of these studies. It is concluded in this and in the final chapter that much more intensive use will be made of the range resource in the future.

The chapter on marketing describes the marketing process in general, with little depth in any area. The concluding chapter is a mixture of predictions by the author and others, along with techniques for individual ranch planning. A rather optimistic future for ranching is predicted based largely on increasing domestic population and incomes.

Dr. Gray has been closely associated with this subject for several years and has a thorough knowledge of the industry. The book is replete with results of studies done in the West. His familiarity with the complex subject may have led to the inclusion of so many subjects, few of which are treated in any depth. The book purports to be designed for ranchers and students. As with many attempts to satisfy two audiences, the results are not entirely satisfactory to either group. It seems that the treatment of economic theory is somewhat obscure for classroom use. The book contains over 500 pages; however, treatment of most issues is so cursory that ranchers will have to resort to other sources for further assistance.

Individuals interested in the livestock industry or the range resource will find selected portions of this book of interest. It also provides a rather good bibliography of research done on ranching in the West.

LEROY ROGERS
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Myrdal, Gunnar, *Asian Drama, An Inquiry into the Poverty of Nations,* 3 vols., New York, Pantheon Books, 1968, xxix + 2284 pp. ($8.50 paper, $25 cloth.)

Anyone seriously interested in the development problems of South Asia should own a copy of, or have access to, this work. It is a vast repository of information concerning the political, sociological, and economic aspects of the development of South Asian countries. But it is not a work that anyone would *want* to read straight through anymore than one would want to read an encyclopedia straight through—and for the same reasons. Myrdal's *Asian Drama* is an encyclopedic work of development problems of South Asia. And, although I personally have a deep commitment to the development problems of that area, *Asian Drama* pressed more knowledge on me in one short period of time than I was seeking or could absorb.

Employing both an historical and an institutional approach, Gunnar Myrdal and a team of assistants have produced a great reference work on the development problems of South Asia. And it is in these terms that the work should be judged and used, although it is probable that Myrdal would not want his work, *Asian Drama,* judged in this manner. He argues in the Preface, ". . . what I have reached for in this book . . . is a tentative theory, one that coordinates in a systematic manner a general conception of what is happening in the region of South Asia. . . ." And in the Prologue Myrdal states, "The title of the book, *Asian Drama,* was chosen in order to express the conception of events in South Asia held by the author at the beginning of his work and fortified in the course of study. Behind all the complexities we sense a rather clear-cut set of conflicts and a *common theme* as in a drama [italics mine]. The action in this drama is speeding toward a climax. . . ." So Myrdal feels that a general theory, or a theme, or an approach, binds together in a unified whole the many facets of this huge work on South Asia. Perhaps. But this reviewer did not find the unifying theme. For him it remains an important reference work on the political, social and economic conditions of South Asia in a developmental setting.

In the sense of a reference work, Myrdal and his assistants describe in detail the political history of the region, including the partition of Imperial India and other border disputes; the economic realities of the region, including detailed discussions of population and resources, national output, and structure of the economy, levels of living, and foreign trade; problems of labor utilization in agriculture and industry; agricultural policy; population policy; and problems of population quality, including health, education, and school systems. The discussion of each of these subject areas usually is developed in depth with respect to India, and somewhat more superficially for the other countries of the region.

This reviewer found "Part Four: A Third World of Planning" the most instructive and most important section of the book. In this section, Myrdal deals with the spread of the ideology of planning; the paradox of egalitarian objectives and social and income inequality; the dilemma of the "soft state," which seeks reform but requires little of its citizens; the cumulative tendency toward excessive and discretionary controls over the private sector; and the causes and effects of corruption. For the person concerned with economic development but unfamiliar with social and political conditions in South Asia, this section must be highly revealing; for the person who has worked in South Asia (as the reviewer has), this section helps one to understand the quagmire from which he could never quite extricate himself. In this sense, this section is instructive.

But the ideas developed in this section have a greater importance—a greater relevance. Myrdal tells the political and intellectual leaders of South Asia some hard truths about themselves, which they must come to appreciate and to act upon, if they are ever to achieve the rates of economic growth to which they aspire. Myrdal states boldly, for example . . . "there is little hope in South Asia for rapid development without greater social discipline. . . ." This is strong medicine, but from the liberal, Myrdal, the political leaders and intellectual elite are swallowing hard and taking it (certainly no American could discuss the "soft state" and government corruption the way Myrdal has, and still find acceptance in India). But reviews of *Asian Drama* in Indian Newspapers and Journals in late spring of 1968 suggest that the message in this part of the book is being discussed with reasonable calm and accepted to some degree, regardless of the hurt to national pride.

Myrdal devotes two chapters to agriculture. The first entitled "Labor Utilization in Traditional Agriculture" delves deeply in the structure of rural society, including village life, and rates and forms of labor utilization under varying institutional arrangements. This is an excellent chapter, providing a careful description of working conditions and arrangements in rural areas—primarily in rural India. The second chapter entitled "Agricultural Policy" deals with the need to increase food production and takes up the technical possibilities and the institutional restraints. But he misses completely the important technological developments that have occurred in the agriculture of South Asia in the past few years. In part, this is due to the cut-off date of the book, July 1967. But more important, it is due to Myrdal's preoccupation with institutional developments. He argues in this chapter that:

> The major theme of our analysis will be that the success of technological reforms, designed primarily to increase the cultivated acreage and raise agricultural yields through variations in techniques and the input of capital, hinges largely on the extent of prior, or at least simultaneous, institutional changes.

Concentrating on institutional changes, Myrdal has missed completely the technological revolution that is now occurring in food grain production in South Asia. Like another great master, Malthus, Myrdal has failed to observe the technological dynamics of agriculture at a time of very great importance, through his preoccupation with other matters—in this case institutional changes in agriculture.

When one has finished reading chapter 33, the final chapter of *Asian Drama* (on page 1,828), he has not finished the work. There remain 378 additional pages of appendices. This reviewer did not read all of these appendices, but he did read appendix 2, "The Mechanism of Underdevelopment and Development and a Sketch of an Elementary Theory of Planning for Development," and as in Marshall's Principles, some of the most illuminating material in the book is to be found in the appendices. Appendix 2 is a must reading for anyone concerned with "The Theory of Planning for Development," and probably will become as well known and as well used as appendices 1 and 2 dealing with "Valuations" in *An American Dilemma.*

Again let me repeat that *Asian Drama* is a work that anyone specializing in development problems, or South Asia, will want to own. It is a great reference work, which probes in depth many, many political, social, and economic problems of South Asia. But it is not the kind of a work that one reads straight through either for pleasure or in pursuit of a logical theory or a general conceptual picture. *Asian Drama* comes close to duplicating South Asia itself for variation, complexity, and size.

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Weymar, F. Helmut, *The Dynamics of the World Cocoa Market,* Cambridge, The M. I. T. Press, 1968, ix + 253 pp. ($15.00)

This research monograph is likely to be of value to traders, students of price theory, and econometricians. For traders, it describes the cocoa market for the 1953–63 period. Students of futures markets will find a revision of the "supply of storage theory" explaining monthly price movements. Econometricians will want to evaluate the transition from theory to empirical measurements, the use of *a priori* information, and the unusually varied series of tests applied to the results.

Inevitably, the study begins with a description of the world cocoa market. It identifies the major fluctuations of the market due to changes in consumption (as when Britain ended war controls) and in production (as when Brazil attempted to improve prices by withholding supply in 1957–58). It also describes the procedures actually used by traders to forecast the size of the annual crop, because forecasts play an essential role in the behavior of commodity prices. This description is supplemented by a month by month analysis of the market over ten years. The 120 paragraphs are kept in an appendix for the benefit of the cocoa trader or the dedicated reader.

No attempt is made to analyze the long-run response to price. This is a perfectly legitimate decision because a cocoa tree can be kept in production for more than forty years. The study deals with a price-consumption sub-system which must explain the nature of the relationships and adjustment lags between prices, inventories, expectations regarding inventories, consumption, and consumption expectations, as they respond to variations in world cocoa production. These five endogeneous variables do not appear explicitly in the final derived sub-system which includes only a spot price equation, a consumption equation, and a consumption-expectations equation. These equations are estimated separately.

The spot price equation is the most important of the three. It is based on a revised form of the "supply of storage theory" which was previously published by the author in the *American Economic Review* of December 1966. This theory says that "the spread between the spot price and expected spot price and/or the futures price relating to some relatively distant horizon time is a function of expected inventory behavior over the horizon interval" [p. 51]. Working's earlier conclusion is that intertemporal price spreads are "in general determined by the existing inventory level alone and not by events expected in the future" [p. 57]. This apparent contradiction vanishes when the author shows that Working's conclusion is applicable to observations over shorter time periods, like three months. The result is a welcome clarification. The theory is well presented and provides a useful reference for further discussion.

The conclusion of the theory is that the spot price can be approximately stated as a function of the current inventory ratio, the forecasted inventory ratio for some finite horizon, and the expected long-run equilibrium levels of price and inventory ratio. One month is used as the time unit for the estimation. When such information is not available, appropriate time series are constructed. The final form of the spot price function is reached through a series of intermediate regressions and equation substitutions. This weakens the value of the results for a test of the revised supply of storage theory. Moreover, it seems that at one step the author has overlooked an identification problem. In the elimination of the first term of equation number 4.23 [p. 71], the use of long-run equilibrium conditions forces a specific value on $ln\overline{V}^{*}s$, the logarithm of the expected end-of-year inventory ratio. This value differs from the results on page 76.

Once the spot price function has been estimated, it is subjected to several tests. It is found that a trend equivalent to the trend in cocoa production should be added to the long-run equilibrium price level. The parameter estimates have plausible values, although some are very close to the lower bounds of the previously established *a priori* range for the estimates. An F-test applied to two sets of estimates obtained by dividing the sample into two periods shows that, despite a good fit, the estimated structure is not stable. The results over the entire period explain 94 percent of the variance of the monthly average cocoa price. To eliminate the influence of serial correlation, which is inevitable when working with monthly data, the definitive spot price equation is estimated by generalized least-squares.

Of the two remaining equations of the system, the consumption equation is estimated in two ways. A first form is estimated indirectly on a quarterly basis using several forms of lagged responses to price changes. It fails to account for the impact of income, a time trend and the impact of the price of sugar, and it is replaced by another form based on direct estimation. Finally, there is an equation representing consumption expectations. In estimating these equations, as in the rest of the study, the author displays skills and cleverness in using the data, especially when he uses *a priori* information to handle expectations. The statistical results are again quite good.

Once the entire price-consumption subsystem has been estimated, its dynamic properties are tested in several ways. First, a test of the impact of actual exogenous variables on the system shows that endogenous variables are well predicted. A further test provided by the comparison of the cross-variance function between the exogenous producer sales and the endogenous consumption rate for actual and simulated variables is also satisfactory. But, why not test price movements as well? Finally, the author investigates the resonance properties of the system. Starting with a set of well-defined initial conditions, he studies how the system filters a periodic disturbance added to steady-state variables. This procedure allows him to investigate reactions to stochastic as well as deterministic variations. A "gain function" between price and consumption tends to show that the sub-system filters out very short periods and favors periods over nine years of length. An estimation of the response to a 20 percent crop failure confirms this sensitivity to a nine-year period. Does this have empirical implications for the stabilization of the market?

This is a good study. It achieves its purpose of describing the essential features of the world cocoa market. It avoids a common weakness of other studies in its effort to develop an appropriate theory before making empirical measurements. The author displays remarkable skills in handling the data and in making use of all the information available; his introduction of a variable time span in the estimated spot price function is very interesting. However, he cannot extricate himself from the dilemma of choosing between generating data to fit an acceptable theory and adjusting the theory to fit the existing information. He personally favors the first alternative. As time passes, it will take more and more of this kind of effort to dispel the current uneasiness about econometric studies which stand halfway between economic theory and reality. We have here a serious reference work for economists and econometricians studying the behavior of soybeans, coffee, sugar, and other commodity prices.

BERTRAND RENAUD
University of Hawaii

Yotopouolos, Pan A., ed., *Economic Analysis and Economic Policy*, Training Seminar Series 6, Athens, Center of Planning and Economic Research, 1966, 205 pp. (Price unknown)

This book consists of six chapters written by six different authors. The subject matter of the book deals with economic planning, particularly investment analysis. It does not cover the broad spectrum of economic analysis and policy, as the title of the book may imply. Within this subject matter, the central theme of the book is, in the editor's words, "to circumstantiate the nature of the contribution that the economist can make in the shaping of policy recommendations." The book turns out to be primarily about the applications of cost-benefit analyses to actual projects.

The first four chapters go together quite well and are not difficult reading. The beginning graduate student should have little trouble with these. However, there is little in these that will interest the economist specializing in investment analysis. The last two chapters, and particularly the last one, will appeal only to the specialist. It is even difficult for anyone but the specialist to see the logical tie-in of these chapters with the rest of the book.

The first chapter, by Goldberger, stresses the need for interplay between the economist and the policymaker. It is assumed that the policymaker is the best qualified to specify the welfare function for society and he should do so. Goldberger ignores the problems and controversies surrounding this assumption. The economist's role is to call to the attention of the policymaker variables that must be changed to meet the desired levels of the goals. If some of these variables have values attached, then the policymaker must decide the levels of all variables having values. The economist specifies the relationships among the variables.

The second chapter, written by Tillo Kuhn, sketches an overall framework for investment analysis. Subsequent chapters fit into this framework, but they elaborate only on a few of the topics sketched. The framework deals with the applied problems of investment analysis, such as defining the analytical boundaries and goals of the problem, getting an inventory of means and environmental factors, and choosing the best tools to make the choice among various means. The chapter also includes the results of analyzing a number of past research projects and shows some startling weaknesses in these projects. The main lesson of this chapter is the discrepancy that exists between what can be done with existing tools and what actually has been done.

The third chapter, by Berney, shows that factors other than profits should be taken into consideration in investment analysis. He emphasizes the alternative uses of scarce government funds and the level of employment. He also outlines a scheme for establishing discount rates by constructing a demand schedule for investment funds.

The fourth chapter, by Kyrtsis, is a hypothetical example of an investment that is unprofitable for private enterprise but profitable for the government. The difference lies in the prices relevant to each group.

Readers of this journal will find the fifth chapter familiar, as a shorter version of it was published in the May 1967 issue [p. 476]. The basic argument of this chapter is that the irregularity of service flows from stocks leads to a bias in production function coefficients when the stocks themselves are used. Methods for estimating service flows are presented. An empirical example shows that the flow concept does a better job of estimating coefficients than does the use of capital stock.

The final chapter concerns efficient paths of capital accumulation and is a subset of the literature that has evolved from the basic framework of Chapter 12 of Dorfman, Samuelson, and Solow. This chapter shows that the proportion of the first period envelope that will lead to the efficient envelopes in subsequent periods is very small. This implies that there is a need for long-range planning, since it is doubtful if the invisible hand will be able to keep the capital allotted to the production of different goods in the optimal proportions.

The book presents some important concepts in the area of applied investment analysis. These ideas are highlighted with actual or hypothetical empirical examples. Many of the concepts are not original and many are more fully explicated elsewhere. The book has to be faulted for weak continuity from chapter to chapter. The book is not a comprehensive treatment of the subject matter. It develops some topics and merely mentions others.

DAVID W. PRICE
Washington State University

Books for listing in this section should be sent to the Book Review Editor (see inside front cover for address).

Books Received

Aid to Agriculture in Developing Countries, Paris, Organization for Economic Cooperation and Development, 1968, 186 pp. $5.00 paper.

Andreano, Ralph L., Evan Ira Farber, and Sabron Reynolds, *The Student Economist's Handbook, A Guide to Sources,* Cambridge, Massachusetts, Schenkman Publishing Company, 1967, x + 159 pp. $1.50 paper.

Behrman, Jere R., *Supply Response in Underdeveloped Agriculture, A Case Study of Four Major Annual Crops in Thailand, 1937–1963,* Amsterdam, North-Holland Publishing Company, 1968, xix + 446 pp. $22.50.

Bradley, James V., *Distribution-Free Statistical Tests,* Englewood Cliffs, Prentice-Hall Inc., 1968, xii + 388 pp. $11.50.

Butterwick, Michael, and Edmund Neville Rolfe, *Food, Farming, & the Common Market,* London, Oxford University Press, 1968, xiv + 259 pp. $7.75.

Epp, Donald J., *Changes in Regional Grain and Livestock Prices under the European Economic Community Policies,* Res. Rep. 4, East Lansing, Institute of International Agriculture, Michigan State University, 1968, ix + 131 pp. $2.00 paper

Goldberger, Arthur S., *Topics in Regression Analysis,* New York, The Macmillan Company, 1968, x + 144 pp. $6.95.

Homer, Sidney, Paul W. McCracken, James J. O'Leary, and Henry C. Wallich, *The Five-Year Outlook for Interest Rates,* Chicago, Rand McNally & Company, 1968, xi + 89 pp. $5.95.

Inter-American Committee for Agricultural Development (Comité Interamericano de Desarrollo Agrícola), *Estudio de Educación, y Extension Agrícolas—1966—Centroamérica,* Washington, D.C., Pan American Union, 1967, (in Spanish), xviii + 369 pp. Price unknown Paper.

International Cooperative Alliance, *Agricultural Cooperative Credit in South-East Asia,* New York, Taplinger Publishing Co., 1968, viii + 184 pp. $5.25.

Jaehne, Günter, *Landwirtschaft und landwirtschaftliche Zusammenarbeit im Rat fur Gegenseitige Wirtschaftshilfe (COMECON),* Wiesbaden, Otto Harrassowitz, 1968, 327 pp. Price unknown. Paper.

James, Sydney C., ed., *Midwest Farm Planning Manual.* 2nd ed., Ames, The Iowa State University Press, 1968, vii + 345 pp. $5.95.

Kerr, H. W. T., *Farm Planning Handbook*, 3rd ed., Leicestershire, England, University of Nottingham, 1968, 82 pp. 8s. 6d. Paper.

Koester, Ulrich, *Theoretishe und empirische Analyse der Nachfrage nach Nahrungs–und Genussmitteln auf der Verbraucher–und Erzeugerstufe, Bundesrepublik Deutschland 1950/51–1965/66,* Band 1: *Allgemeine Analyse der Nachfrage nach Nahrungs–und Genussmitteln, Agrarwirtschaft,* Sonderheft 27, Hannover, Alfred Strothe Verlag, 1968, 264 pp. Price unknown.

Mangum, Fred A., Jr., *The Grain-Livestock Economy of Italy with Projections to 1970 and 1975*, Res. Rep. 2, East Lansing, Institute of International Agriculture, Michigan State University, 1968, x + 179 pp. $2.00 paper.

Mathew, E. T., *Agricultural Taxation and Agricultural Development in India, New York,* Taplinger Publishing Company, 1968, 204 pp. $7.50.

McPherson, W. W., ed., *Economic Development of Tropical Agriculture, Gainesville,* University of Florida Press, 1968, xvi + 328 pp. $8.50.

Olson, Mancur, Jr., *The Logic of Collective Action, Public Goods and the Theory of Groups,* New York, Schocken Books, 1968, xi + 176 pp. $1.95 paper.

Orwin, Christabel S., and Edith H. Whetham, *History of British Agriculture 1846–1914,* New York, Humanities Press, Inc., U. S. ed. 1969, xx + 411 pp. Price unknown.

Papanek, Gustav F., ed., *Development Policy–Theory and Practice,* Cambridge, Harvard University Press, 1968, xvi + 367 pp. $12.50.

Petit, Michel J., and Jean-Baptiste Viallon, *The Grain-Livestock Economy of France with Projections to 1970 and 1975,* Res. Rep. 3, East Lansing, Institute of International Agriculture, Michigan State University, 1968, xi + 253 pp. $2.00 paper.

Rural Poverty in the United States, A Report by the President's National Advisory Commission on Rural Poverty, Washington, Superintendent of Documents, U. S. Government Printing Office, 1968, xii + 601 pp. $5.75.

Schultz, Theodore W., *Economic Growth and Agriculture,* New York, McGraw-Hill Book Company, 1968, x + 306 pp. $9.95.

Shirley, Hardy L., and Paul F. Graves, *Forest Ownership for Pleasure and Profit,* Syracuse, Syracuse University Press, 1968, vii + 214 pp. $5.50.

Sills, David L., ed., *International Encyclopedia of the Social Sciences,* 17 vol., New York, The Macmillan Company and The Free Press, 1968, xxx + 9750 pp. $495.

Sorenson, Vernon L., and Dale E. Hathaway, *The Grain-Livestock Economy and Trade Patterns of the European Economic Community with Projections to 1970 and 1975,* Res. Rep. 5, East Lansing, Institute of International Agriculture, Michigan State University, 1968, xi + 123 pp. $2.00 paper.

Talbot, Ross B., and Dan F. Hadwiger, *The Policy Process in American Agriculture.* San Francisco, Chandler Publishing Company, 1968, xii + 378 pp. Price unknown.

Trant, Gerald I., David L. MacFarlane, and Lewis A. Fischer, *Trade Liberalization and Canadian Agriculture,* Canada in the Atlantic Economy 4, Toronto, Private Planning Association of Canada, University of Toronto Press, 1968, vii + 119 pp. $3.50 paper.

Vinge, C. L., and A. G. Vinge, *Economic Geography,* Totowa, New Jersey, Littlefield, Adams and Company, 1966, ix + 368 pp. $3.45 paper.

Weymar, F. Helmut, *The Dynamics of the World Cocoa Market,* Cambridge, The M. I. T. Press, 1968, xv + 253 pp. $15.00.

Yotopoulos, Pan A., ed., *Allocative Efficiency in Economic Development,* Research Monograph Series 18, Athens, Center of Planning and Economic Research, 1967, 313 pp. Price unknown.

Announcements

1969 AAEA ANNUAL MEETING

The 1969 Annual Meeting of the AAEA will be held on August 17–20 at the University of Kentucky, Lexington, Kentucky.

Dr. Robert W. Rudd is Chairman of the Department of Agricultural Economics and Dr. John C. Redman is in charge of local arrangements. Suggestions or requests, including needs for space for committee sessions to be held before or after the meeting, should be addressed to Dr. Redman.

Suggestions for the program should be sent to President Harold F. Breimyer, Department of Agricultural Economics, University of Missouri, Columbia, Missouri 65201.

CONTRIBUTED PAPERS—1969 AAEA ANNUAL MEETING

Contributed papers in any area of agricultural economics are solicited. Priority in selection will be given to papers that identify new or neglected problems, or that demonstrate or propose new approaches, new concepts or improved methods applicable to recognized problems. Contributions treating collegiate and adult teaching as well as research are encouraged.

At least four sectional meetings are planned for contributed papers with a maximum of four papers in each session. The specific subject matter groupings for each session will be determined by the papers submitted.

Rules for Submitting Contributed Papers

1. The maximum length of any contributed paper shall be seven double-spaced typed pages including text and all other material such as footnotes, tables, and charts. Place all references, alphabetized by author, in a numbered list at the end of the paper in a section titled "References." When you refer in the text to a publication on this list, insert its number in brackets, including specific page number if necessary. Example: [7, p. 643]. See "Guide for Submitting Manuscripts" on the inside of the back cover of the *American Journal of Agricultural Economics.*

2. Five copies of the paper and a one-page abstract are to be submitted to the general chairman before May 1, 1969. The general chairman will group the papers and forward them to section chairmen, notifying each author of the group to which his paper was assigned. The abstract will be used as a guide for grouping the papers.

3. It shall be the responsibility of each section chairman in consultation with several of his departmental colleagues to select four papers for presentation at the annual meeting.

4. It is recommended that 50 copies of the contributed papers be brought to the annual meeting by the author for distribution.

The following committee is in charge of the program: Milton Manuel, Kansas State University, general chairman; Sharon Hoobler, U. S. Department of Agriculture, Washington, D.C.; Raymond Leuthold, University of Illinois; Chester McCorkle, University of California, Davis; Travis Manning, University of Alberta; and Andrew Vanvig, University of Wyoming.

Requests for further details should be directed to the general chairman, Milton Manuel.

UNDERGRADUATE DEBATE, PUBLIC SPEAKING, AND ESSAY COMPETITIONS

Competition is open to any undergraduate student interested in agricultural economics. Participants are encouraged to become members of chartered student-section affiliates of the American Agricultural Economics Association but such membership is not required to enter the various contests. No individual student may enter both the debate and the public speaking competitions in the same year.

Public Speaking Competition

The public speaking may be on any topic in the area of agricultural economics. Each speech will be limited to 10 minutes' duration.

Chartered chapters or individuals must declare their intention of participating in the public speaking competition by writing not later than June 1, 1969, to Kenneth B. Boggs, Chairman, AAEA Student Activities Committee, Department of Agricultural Economics, University of Missouri, Columbia, Missouri 65201.

Debate Competition

The topic to be debated in 1969 is

Resolved: That federal legislation should be enacted to retard nonfarm corporate firms from either the operation or ownership of farms.

A declaration of intention to participate in the debate competition must be made in writing not later than June 1, 1969, to Kenneth B. Boggs, at the address given above. Names of contestants and/or alternates and coaches, along with the mailing address of each, should be included. Not more than one debate team from one school may participate in the debate contest.

Student Essay Contest

The essay contest does not require attendance at our annual summer meeting. It was developed primarily to provide an opportunity to participate for students who find it impossible to attend the annual meetings and for students whose abilities and interest tend to be in research and/or writing. The development and preparation of a manuscript for purposes of publication is one of the objectives of this contest. Essays may deal with any topic in agricultural economics, agricultural industries, or rural sociology. The 1969 award paper will be published in the 1969 Proceedings issue.

Manuscripts should not exceed 2,500 words in length and should be prepared according to instructions appearing on the inside of the back cover of the *American Journal of Agricultural Economics.* Manuscripts must be submitted in triplicate by July 1, 1969, to Robert Taylor, Department of Agricultural Economics, Purdue University, Lafayette, Indiana 47907.

AAEA DUES

Dues for 1969 are payable. The dues rates are as follows:

Regular membership	$10.00
Junior membership (graduate students, 3-year maximum)	5.00

Please mail your check, payable to the American Agricultural Economics Association or AAEA, to C. D. Kearl, Secretary-Treasurer, AAEA, Department of Agricultural Economics, Cornell University, Ithaca, New York 14850.

(The Executive Board of AAEA has discontinued joint memberships with other associations; in succeeding issues, we will provide information concerning membership requirements of other associations.)

BACK ISSUES NEEDED

The Secretary-Treasurer of the AAEA is authorized to pay $1.00 each for any of the issues of the JFE listed below.

Year	*Volume*	*Issues*	*Year*	*Volume*	*Issues*
1919	1	1, 2, 3	1951	33	1, 2, 3
1920	2	1, 2, 2, 4	1952	34	5
1921	3	1, 2, 3, 4	1953	35	1, 5
1922	4	1, 2, 3, 4	1954	36	2
1923	5	1, 2, 4	1955	37	1, 2, 3, 4, 5
1924	6	1, 2, 3, I	1956	38	1, 2, 5
1925	7	1, 2, 4, I	1957	39	1, 2
1926	8	1, 2, 3, 4, I	1958	40	2
1935	17	1	1959	41	1, 3
1940	22	1	1960	42	1, 4, 5
1942	24	2	1961	43	2, 3
1943	25	1, 2, 3, 4	1962	44	1
1944	26	2, 3, 4	1963	45	1, 4, 5
1945	27	1, 2, 3, 4	1964	46	2, 3
1946	28	1, 2, 3, 4	1965	47	1
1947	29	1, 2, 4–1	1966	48	3–1
1948	30	1	1967	49	1–1, 1–2

JOURNALS should be mailed to C. D. Kearl, AAEA, Dept. of Agricultural Economics, 455 Warren Hall, Cornell University, Ithaca, New York 14850.

News Notes

UNIVERSITY OF ARIZONA

Appointment: **Resat Aktan**, University of Ankara, Turkey, visiting professor, 1968–69.

Leaves: **Robert S. Firch** (AJAE Editorial Council), sabbatical, Stanford, Fall 1968; **Robert A. Young**, Resources for the Future, Washington, D.C., 1968–69.

UNIVERSITY OF ARKANSAS

Appointments: **J. Martin Redfern**, assistant professor, resource economics; **Ralph Gene Martin**, M.S. Arkansas, 1968, and **Clyde Stuart, Jr.**, M.S. Arkansas, 1968, instructors.

UNIVERSITY OF CHICAGO

Appointments: **Hans Joachim Bodenhoefer**, Technische Universitat, Berlin, and **Franciszek W. Budzynski**, Warsaw Agricultural University, Ford Foundation Post-Doctoral Fellows; **D. P. Chaudhri**, Delhi University, Rockefeller Foundation Post-Doctoral Fellow; **Steven C. Cheung**, assistant professor; **Barry R. Chiswick**, University of California, Los Angeles, visiting professor; **Joseph L. Havlicek**, Purdue University, Faculty Fellow; **Tara Shukla**, University of Bombay, Post-Doctoral Fellow of Agricultural Development Council and Department of Economics.

Awards: **Theodore W. Schultz**, Doctor of Laws, University of Illinois and University of Wisconsin, 1968.

COLORADO STATE UNIVERSITY

Appointments: **Edward K. Smith**, formerly deputy assistant secretary of Commerce, chairman, department of economics. Additional appointments in economics: **Richard C. Barth**, **Huntley H. Biggs**, **Terutomo Ozawa**, assistant professors; **Rodney D. Peterson**, **Liang-Shing Fan**, associate professors; **Robert L. Darcy**, **Richard G. Walsh**, professors; **Donald M. Sorenson**, extension assistant professor; **Robert E. Whedbee**, faculty affiliate.

Leave: **Loyal M. Hartman**, sabbatical, Harvard.

CORNELL UNIVERSITY

Leaves: **Solon L. Barraclough**, returned from extended leave at the Chilean Agrarian Reform Training and Research Institute, Santiago; **David L. Call**, sabbatical, Massachusetts Institute of Technology; **William G. Tomek**, sabbatical, Food Research Institute, Stanford.

AWARDS: **Glenn W. Hedlund**, annual Agricultural Counselor Award, Farm Credit Banks of Springfield, Massachusetts; **Clifton W. Loomis**, annual Epsilon Sigma Phi Achievement Award for excellence in extension work; **E. A. Lutz**, Fullbright Award at Royal College of Agriculture, Norway.

DUNLAP and ASSOCIATES, INC.—AGRI RESEARCH DIVISION (Manhattan, Kansas)

APPOINTMENTS: **James K. Allwood**, M.S. New Mexico State, 1968; **Larry Bedford**, M.S. Missouri, 1968; **Gary Mennem**, M.S. Oklahoma State, 1968; **Burton Tribble**, M.S. candidate, Kansas State; **Barry Rhine**, graduate student, Kansas State.

ECONOMIC RESEARCH SERVICE, USDA

(EDD is Economic Development Division; ESAD is Economic and Statistical Analysis Division; FAS is Foreign Agricultural Service; FDTD is Foreign Development and Trade Division; FPED is Farm Production Economics Division; FRAD is Foreign Regional Analysis Division; MED is Marketing Economics Division; NRED is Natural Resource Economics Division; PASA is Participating Agency Service Agreement; SRS is Statistical Reporting Service.)

APPOINTMENTS: **Walter Armbruster**, MED, at Corvallis; **Sanford Belden**, MED, at Purdue; **Larry M. Boone**, formerly University of Tennessee, 2-year assignment in Colombia on USAID/PASA team; **Walter E. Epps**, formerly Battelle Memorial Institute, MED; **Russell L. Gum**, FPED, at Tucson; **Blake Imel**, MED, at Berkeley; **Edward Jesse**, MED, at Madison (NCM-44 Regional Project); **Richard Johnson**, NRED, at East Lansing; **Philip L. Mackie**, Ph.D. Maryland, 1968, FAS at Washington, D.C.; **Masao Matsumoto**, MED, at Berkeley; **Willis Middlemiss**, NRED, at Corvallis; **Malek M. Mohtodi**, formerly Utah State University, FRAD; **Terry L. Roe**, Ph.D. candidate, Purdue, MED, at St. Paul; **J. Newell Sorenson**, NRED, at Bismarck; **Bruce H. Wright**, MED.

TRANSFERS: **Fred H. Abel**, from FPED to EDD; **John H. Berry**, FPED, from Lafayette to Urbana; **John Braden**, NRED, from Little Rock to Alexandria, Louisiana; **Lee Christiansen**, NRED, from Lincoln to East Lansing; **Richard Cowled**, from NRED to Forest Service; **Arthur Daugherty**, NRED, from Washington, D.C. to University Park, Pennsylvania; **Merlin Erickson**, NRED, from Temple, Texas, to Lincoln; **Henry C. Gilliam, Jr.**, FPED, from Clemson to Raleigh; **Wade F. Gregory**, FDTD, to USAID/PASA, Colombia (2 years); **Jerald Gunnelson**, MED, from Lafayette to Madison; **Richard Hall**, MED, from 2-year assignment in Bolivia; **Hugh A. Johnson**, NRED, from Temple, Texas, to Jackson, Mississippi; **Ray Lanier**, NRED, from East Lansing to Berkeley (to be leader of new Southwest Resources Group); **Dallas Lea**, NRED, from Morgantown to Washington, D.C.; **Percy Luney**, NRED, to 1-year assignment as staff assistant to ERS Administrator; **Donavon D. MacPherson**, USAID/PASA, from Ecuador to Paraguay (2 years); **Nathan Mallett**, NRED, from Ann Arbor to Washington, D.C.; **Neil R. Martin, Jr.**, FPED, from Athens, Georgia to Urbana; **Howard A. Osborn**, USAID/PASA in Bolivia to FAO in Mexico (2 years, on world census of agriculture); **James Schwinden**, USAID/PASA, from El Salvador to Colombia; **Bobby H. Robinson**, FPED, from Clemson to Washington, D.C.; **W. Neil Schaller** (AJAE Editorial Council), from

FPED to International Agricultural Development Service, USDA, Washington, D.C.

LEAVES: **Wendell Clement**, MED, to Federal City College (new Land Grant College in Washington, D.C.), 1 year, to develop marketing program; **Allen B. Paul** (AJAE Book Review Editor), MED, to University of Hawaii, 1968–69.

RESIGNATIONS: **Alvin C. Egbert**, to International Bank of Reconstruction and Development; **Ivan Hanson**, NRED, to Planning Research Corporation, Washington, D.C.; **Frederick J. Rafeld**, FPED, to Louisiana State University; **Paul E. Tix**, FPED, to St. John's University.

AWARDS: **Gene Harris**, NRED, Little Rock, National Institute of Public Affairs 1-year career training award, Stanford University; **Adrian Haught**, NRED, Upper Darby, National Institute of Public Affairs 1-year training award, University of California, Irvine.

EXTRAORDINARY: **Wells Hutchins**, 80, celebrated his 60th anniversary as a USDA employee on July 27, 1968. Since his retirement in 1958, he has been reemployed each year in the Natural Resource Economics Division to complete his multi-volume work on the water laws in western states.

UNIVERSITY OF FLORIDA

APPOINTMENTS: **Wallace K. Boutwell**, Ph.D. North Carolina State, 1968, **J. Kamal Dow**, formerly with Deere & Company, **Fred H. Tyner**, formerly of Louisiana State, associate agricultural economists

AWARDS: **Max R. Langham**, 9-month Faculty Development Grant, University of Minnesota; **Stanley E. Rosenberger**, 9-month Faculty Development Grant, Purdue University.

UNIVERSITY OF GEORGIA

APPOINTMENTS: **David E. Weisenborn**, Ph.D. Florida, 1968; **Floyd W. Williams**, associate professor; **L. Harlan Davis**, formerly with Agency for International Development, Bogota, Colombia, and **John W. Nixon**, Ph.D. candidate, Michigan State, assistant professors.

UNIVERSITY OF ILLINOIS

APPOINTMENTS: **W. D. Buddemeister**, formerly of USAID, Jawaharlal Nehru Agricultural University, India, associate head of department and assistant director, International Programs of College of Agriculture; **Melvin Wagner**, formerly of the Agricultural Development Council, Kasetsart University, Thailand, and **Harold D. Guither**, associate professors; **Alfred G. Harms**, associate professor, assigned to Uttar Pradesh Agricultural University, India; **Takashi Takayama**, formerly with University of New England, N.S.W., Australia, joint professorship in economics and agricultural economics; **Ian Marceau**, Ph.D. Illinois, 1968, assistant professor of computer science; **Howard R. Peverly**, M.S. Illinois, 1968, fieldman, Illinois farm business farm management service, Morrison; **Willitt Pierce**, M.S. Illinois, 1968, statistical service unit; **Erman E. Schairer**, M.S. Illinois, 1968, fieldman, Illinois farm business farm management service, Bloomington.

LEAVES: **Robert P. Bentz**, assistant to vice president, University of Illinois, until July 1, 1970; **J. M. Holcomb**, Ford Foundation, Intensive Agricultural

Development Program, New Delhi, India; **Stephen C. Schmidt**, sabbatical, University of Manitoba; **Robert B. Schwart**, 2-year appointment at Uttar Pradesh Agricultural University, India.

RESIGNATION: **Roger J. Vandenborre**, to Docent (associate professor), Department of Applied Economics, University of Louvain, Belgium.

IOWA STATE UNIVERSITY

APPOINTMENTS: **Ivo Cupic**, Economic Advisor to Economic Chamber of Bosnia and Herzegovina, Sarajevo, Yugoslavia, visiting professor; **Jordan Krsteski**, Faculty of Agriculture and Forestry, Skopje, Yugoslavia, and University Institute of Economics, visiting professor; **Augustyn Wos**, University of Maria Currie-Sklodowska, visiting lecturer.

UNIVERSITY OF MAINE

APPOINTMENTS: **Reginald K. Harlan**, formerly with University of Wyoming Afghanistan Project, associate professor; **S. E. Shehata**, University of Ain Shams, Cairo, Egypt, visiting professor, 1968–69.

LEAVE: **Wallace C. Dunham**, sabbatical, Cornell University (studying for Ph.D.)

UNIVERSITY OF MASSACHUSETTS

APPOINTMENTS: **John Foster**, Director, Center for International Agricultural Studies; **N. Eugene Engel**, acting department head, in absence of **J. B. Wyckoff**, on leave until July 1, 1969; **Robert Christensen**, associate professor; **Robert Forste**, instructor.

MICHIGAN STATE UNIVERSITY

APPOINTMENT: **David Armstrong, associate professor.**

LEAVES: **A. Allan Schmid**, Systems Analysis Group, Washington, D.C.

UNIVERSITY OF MINNESOTA

APPOINTMENTS: **Martin E. Abel**, formerly Deputy Assistant Secretary for International Affairs, Office of the Secretary, USDA, professor; **Willis E. Anthony**, assistant professor and extension economist; **Buddy G. Crewdson**, formerly of Upper Midwest Research Development Council, assistant professor and extension specialist in resource development; **Mathew D. Shane**, Ph.D. candidate, Purdue, assistant professor.

LEAVES: **Robert E. Evenson**, visiting professor, Southern Methodist University, Dallas, 8 months; **James P. Houck, Jr.**, Agricultural and Technical State University, Greensboro, North Carolina, 1969 spring quarter.

UNIVERSITY OF MISSOURI

APPOINTMENTS: **Kenneth C. Schneeberger**, Ph.D., Oklahoma State, 1968, assistant professor; **Roger Halstead**, M.S. Missouri, 1968, farm management agent.

LEAVES: **Charles L. Cramer**, Harvard (6 months); **Dale K. Colyer**, Fullbright lecturer, Argentina, July-November 1968.

MONTANA STATE UNIVERSITY

APPOINTMENTS: **Richard J. McConnen**, department head, replacing **Clarence Jensen**, resigned to resume as professor; **Oscar R. Burt**, formerly at Missouri, professor; **Martin S. Stauber**, Ph.D. Missouri, 1968, and **Michael D. Copeland**, Ph.D. candidate, Colorado, assistant professors.

LEAVES: **Edward H. Ward**, 2-year assignment, Agricultural Development Council, Boger, Indonesia; **Merle Quenemoen**, returned as extension economist after completing 2-year assignment with Oklahoma State University program at Haile Selassie I University, Ethiopia.

AWARD: **Gail Cramer**, Ph.D. Oregon State, 1968, Edwin G. Nourse Award for outstanding Ph.D. thesis, 1968.

NEW MEXICO STATE UNIVERSITY

APPOINTMENTS: **Frank Osterhoudt**, Ph.D. Wisconsin, 1968, and **James Taylor**, Ph.D. Wisconsin, 1968, assistant professors.

OKLAHOMA STATE UNIVERSITY

APPOINTMENTS: **Leo V. Blakley**, acting department head, in absence of **James S. Plaxico**, on leave to Ford Foundation, Bogota, Colombia; **Odell L. Walker**, assistant dean of Graduate College, OSU, ½ time; **Darrel D. Kletke**, Ph.D. OSU, 1968, and **Dean F. Schreiner**, assistant professors.

LEAVE: **Leonard F. Miller**, sabbatical in United States, after 7-year assignment in Ethiopia.

PURDUE UNIVERSITY

APPOINTMENTS: **Gordon D. Honegger**, 2-year post-doctoral assignment for systems analysis in the swine industry; **Josef L. Hesselbach**, Universität Hohenheim, West Germany, visiting professor, one year; **Bertil Johnsson**, Head, Division for Applied Research in Production Economics, Uppsala, Sweden, visiting professor, 1968–69; **Klaus Riebe**, University of Kiel, Germany, visiting professor, September 1968 through March 1969; **Stanley E. Rosenberger**, University of Florida, visiting professor, 1968–69.

AWARDS: **Harry W. Leonard**, honorary American Farmer Degree by the National Future Farmer of America; **Henry A. Wadsworth**, Outstanding Service Award by Purdue Extension Specialists Association.

TEXAS A&M UNIVERSITY

APPOINTMENTS: **John P. Nichols**, Ph.D. Cornell, 1968, **Thomas L. Sporleder**, Ph.D. Ohio State, 1968, **Robert R. Wilson**, Ph.D. candidate, Minnesota, assistant professors; **Chancey C. Connolly, Jr.**, Ph.D. Ohio State, 1968, associate professor at Lower Rio Grande Valley Research and Extension Center, Weslaco, Texas; **Jim McGrann**, M.S. Washington State, 1968, Agricultural Advisor, Texas A&M University/AID Project, Argentina; **John J. Siebert**, extension economist in grain marketing; **John Steele**, Ph.D. Wisconsin, 1968, assistant professor, Argentina research team.

UTAH STATE UNIVERSITY

APPOINTMENT: **Marcelo Peinado**, Ph.D. Wisconsin, 1968, to staff, University's OAS contract in Latin America.

LEAVE: **D. Delworth Gardner**, Resources for the Future, Washington, D.C. one year.

UNIVERSITY OF WISCONSIN

APPOINTMENTS: **Benjamin Villanueva**, Ph.D. Wisconsin, 1968, assistant professor, Land Tenure Center.

LEAVES: **Marvin Miracle**, International Development Research Center, Indiana University, one year; **Kenneth Parsons**, 2-year assignment, University of Wisconsin-AID project in Ibadan, West Nigeria; **John Strasma**, returned as professor after 2½ years as director of Land Tenure Center program and professor in Graduate Economics faculty of University of Chile; **William C. Thiesenhusen**, sabbatical, Harvard.

OTHER APPOINTMENTS

Armed Al-Araji, Ph.D. Missouri, assistant professor, University of Idaho.

Dale O. Anderson, Director, Water Institute, North Dakota State University, replacing **Thor A. Hertsgaard**, resigned to resume as associate professor, NDSU.

A. Wayne Bartholomew, Ph.D. Cornell, 1968, to faculty, Benedict College, South Carolina.

John D. Bates, Ph.D. Maryland, 1968, Marketing Research Division, Giegy Agricultural Chemicals, Ardsley, New York.

Ujagar S. Bawa, Ph.D. Cornell, 1968, to faculty, Wilkes College, Wilkesbarre, Pennsylvania.

Turgut Bayyurt, M.S. Maryland, 1968, Ministry of Planning, Government of Turkey.

Blaine W. Bickel, M.S. Wyoming, 1968, Federal Reserve Bank, Kansas City.

Fred Bordeaux, Ph.D. Michigan, 1968, assistant professor, University of Kentucky.

Theodore Cook, Ph.D. Wisconsin, 1968, International Development Foundation, Santiago, Chile.

Charles M. Cuskaden, Ph.D. candidate, Michigan State, assistant professor, The University of Tennessee.

Stanley G. Detering, Ph.D. candidate, University of California, Davis, lecturer in resource economics.

James L. Driscoll, Ph.D. Oklahoma State, 1968, National Program in Agricultural Marketing, MASUA, Colombia.

Ismail El-Zabri, Ph.D. Illinois, 1968, Near East Branch, FAO, Rome.

Douglas Erikson, Ph.D. Missouri, 1968, assistant professor, Central Missouri State College, Warrensburg.

Raymond Folwell, Ph.D. Missouri, 1968, assistant professor, Washington State University.

Allan R. Frampton, Ph.D. Cornell, 1968, Massey University, New Zealand.

Jerry E. Fruin, Ph.D. candidate, UC, Berkeley, and formerly with General Mills, manager of operations research, finance division, Hamm Brewing Co.

Aklu Girgre, M.S. Maryland, 1968, Ministry of Agriculture, Ethiopia.

Edward Jansen, resource economics faculty, University of New Hampshire.

Ray M. Johns, Ph.D. candidate, Maryland, and formerly with ERS, director of economic development, Calvert County, Maryland.

Paul H. Kipps, Ph.D., Cornell, 1963, to faculty, Madison College, Harrisonburg, Virginia.

Precioso C. Kuhonta, Ph.D. Illinois, 1968, Forest Economics Research Institute, Department of Forestry and Rural Development, Ottawa, Canada.

T. G. Kwon, M.S. Illinois, 1968, Office of Rural Development, Korea.

Teng-Hui Lee, Ph.D. Cornell, 1968, Joint Commission on Rural Reconstruction, Taiwan.

J. Rodney Lemon, Ph.D. Illinois, 1968, assistant professor of economics, Wisconsin State University, Platteville.

Simon Y. LeNaelov, Ph.D. Cornell, 1968, Department of Agriculture, Quebec, Canada.

Joseph V. Leunis, Ph.D. Illinois, 1968, Belgium Boerenbond, Brussels.

Sergio Maturana, Ph.D. Wisconsin, 1968, graduate faculty of economics, University of Chile, Santiago.

Jerry D. Michel, M.S. Wyoming, 1968, Metropolitan Life Insurance Company, Fresno, California.

Vincent R. McDonald, Ph.D. Maryland, 1968, assistant professor of economics, Howard University, Washington, D.C.

William R. Morrow, Ph.D. Tennessee, 1968, assistant professor, Eastern Kentucky State College, Richmond, Kentucky.

Donald Muir, Ph.D. Illinois, 1968, Forest Economic Research Institute, Government of Canada, Ottawa.

Tridib Mukherjee, Ph.D. Maryland, 1968, assistant professor, Fairmont State College, West Virginia.

A. Gene Nelson, Ph.D. candidate, Purdue, assistant professor, Oregon State University.

Ray P. Nightingale, Ph.D. Cornell, 1968, to faculty, American University, Beirut, Lebanon.

David W. Norman, assistant professor, Kansas State University, with 2-year assignment at Ahmadu Bello University, Zaria, Northern Nigeria.

Albert J. Nyberg, Ph.D. Cornell, 1968, Rockefeller Foundation, Nigeria.

Thomas O'Dwyer, Ph.D. Cornell, 1968, Agricultural Institute, Dublin, Ireland.

Erdogan Osmanlioglu, M.S. Missouri, 1968, agricultural economist, Government of Turkey, Ankara.

Luiz Pelligrini, M.S. Purdue, 1968, El Instituto de Economia Rural, Sao Paulo, Brazil.

Javed A. Qureshi, M.S. Maryland, 1968, deputy secretary, Department of Agriculture, West Pakistan.

Rafael Samper, M.S. Purdue, with government in Bogota, Colombia.

Bernard L. Sanders, director of economic and market research, Farmland Industries, Inc., Kansas City, Missouri.

Philip Seaberg, M.S. Wisconsin, 1968, International Milling Company, Minneapolis.

Manu Seetisarn, Ph.D. Illiois, 1968, Department of Land Development, Thailand.

Januk S. Sharma, Ph.D. Illinois, 1968, Uttar Pradesh Agricultural University, India.

Jose S. Silas-Alvarado, Ph.D. Cornell, 1968, consultant for agricultural credit, Bank of Commerce, Mexico.

Michael Thompson, M.S. Illinois, 1968, National Agricultural Advisory Service, Great Britain.

Robert L. Thompson, M.S. Purdue, 1968, International Voluntary Services, Inc., Vientiane, Laos.

Joseph Vandeputte, Ph.D. Illinois, 1968, assistant director of research, Continental Grain Company, New York.

M. Bruce West, M.S. Wyoming, 1968, Statistical Reporting Service, USDA, Sioux Falls, South Dakota.

Earl R. Williams, Ph.D. Tennessee, 1968, assistant professor, Northeastern State College, Tahlequah, Oklahoma.

OTHER LEAVES

Irving F. Davis, Fresno State College, Fresno, California, sabbatical, 1968–69, Instituto Linquistico De Verano, Lima, Peru.

John R. Moore, University of Maryland, 18 months, Ford Foundation, Intensive Agricultural Development Program, India.

OTHER AWARDS

Andrew Schmitz, University of California, Berkeley, the Harold Groves Doctoral Dissertation Award, University of Wisconsin.

OBITUARIES

RICHARD H. ROBERTS, U. S. Agricultural Attache to Canada, passed away at Rimouski, Quebec, October 2, 1968. He had served in the Department of Agriculture for more than 30 years. Prior to entering the Foreign Agricultural Service in 1953, as director of its foreign trade program, Dr. Roberts had served with the Agricultural Adjustment and Production and Marketing Administrations. He had been a delegate to several Food for Freedom conferences and to the Food and Agriculture Organization. A native of Iowa, he received his doctorate from the University of Iowa in 1935.

ELMER JOSEPH WORKING, Professor Emeritus of Agricultural Economics and former chairman of that department at Washington State University, Pullman, Washington, died October 2, 1968, at the University of Colorado Medical Center in Denver, Colorado. Graveside rites were held in Denver. Since his retirement from WSU, Professor and Mrs. Working had lived in Tucson, Arizona.

Dr. Working was born in May, 1900, near Denver, at the Booth-Working homestead where his grandparents had pioneered in 1864. He began his college studies at the University of Denver and was graduated from the University of Arizona in 1921. He received his master's degree at Iowa State University and his doctorate at Harvard University.

He served on the staff of the Brookings Institute in Washington, D.C. and the Bureau of Agricultural Economics, U. S. Department of Agriculture. His early teaching included Iowa State University and the University of Minnesota. From 1935 to 1954, he was professor of agricultural economics at the University of Illinois; in 1954, he returned to the West where he served as chairman of the Department of Agricultural Economics at Washington State University until retirement in 1965. He was subsequently visiting professor at the University of Arizona in Tucson.

Professor Working made numerous contributions to research in agricultural economics. His early article on statistical demand curves is considered a classic in the field of demand and price analysis. It has been described as "a model of penetrating insight, precision of thought, and clarity of presentation."

Dr. Working, a member of Sigma Xi and Phi Kappa Phi, and a Fellow of the Econometric Society, is listed in *Who's Who in America* and other biographical works. He had served as president of the Western Agricultural Economics Association and vice-president of the American Agricultural Economics Association. At its annual meeting in August 1968, AAEA awarded him its highest honor, the designation of Fellow.

Those wishing to remember Dr. Working may send contributions to the Agricultural Economics Memorial Fund, Alumni Office, Compton Union Building, Washington State University, Pullman, Washington 99163, with the notation, "in memory of Dr. Working."

Mrs. Working is living at 5917 East Fourth, Tucson, Arizona.

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EDITOR'S NOTE: Professor Shaffer's article was invited by President Breimyer, whose explanation of its purpose is as follows: "This is a base paper for discussions at the annual meeting of AAEA in Lexington, Kentucky, in August, including a panel concluding the meeting. In addition, contributed papers commenting on this paper are invited. Selected ones will be accepted for presentation at the meeting." These papers must adhere to the rules for contributed papers as they were announced in the February *Journal*, except that (for these papers only) the due date is on or before July 1 and only three copies are required. See announcements section for an additional supplementary note on contributed papers.

On Institutional Obsolescence and Innovation—Background for Professional Dialogue on Public Policy*

JAMES DUNCAN SHAFFER

> **"We ourselves must change to master change. We must rethink all our old ideas and beliefs before they capture and destroy us."**
>
> —ROBERT F. KENNEDY

MY concern in this paper is the process of institutional obsolescence and the necessary activity of institutional innovation. The origin of this concern is my perception of a growing discrepancy between the quality of life enjoyed and that which is potentially attainable. My goal is to stimulate professional discussion regarding the institutions which organize our political economy and the possible role of our profession in the process of institutional change.

Let me briefly sketch the design and argument of the paper. Central to the argument is the notion that, while many of the current problems of the American society are those that have been associated with the industrial system and market economy from their origin, the combination of science-originated technology and industrialization (which I will call scientific industrialization) in a state dedicated to economic growth represents an implicit commitment to constant change in the social order. Greater liberation from the constraints of the environment offers new opportunities for human achievements but, at the same time, requires much more complex and adaptable institutional arrangements that add significant new dimensions to the age-old problems of social organization.

I attempt to show that scientific industrialization imposes a necessity

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* I appreciate comments on an earlier version of the manuscript from H. Breimyer, H. Riley, V. Sorenson, A. Schmid, D. Hathaway, and R. Hildreth, none of whom is responsible for or necessarily agrees with the views expressed.

JAMES DUNCAN SHAFFER *is professor of agricultural economics at Michigan State University.*

for institutional innovation and discuss the introduction of protective institutions. This is followed by an argument that external effects are a pervading problem of the political economy that changes in technology, extent of the market, operating procedures etc., create new patterns of external effects requiring constant institutional adjustment to direct individual efforts to socially desirable ends.

The emerging political economy is the result of the interaction of the processes of scientific industrialization with the political and economic efforts of individuals and groups to take advantage of potential benefits and to achieve protection from the negative effects. A major characteristic has been the development of big bureaucracy, including the giant corporation. Bureaucratic organization is necessary but creates a wide range of policy problems and issues.

Among the policy issues of the emerging political economy are those concerning the organization and control of agriculture, the technological displacement of people and its destructive effects on communities, and the equitable distribution of income. These are briefly discussed, elaborating on the themes developed earlier in the paper.

I conclude with an argument for much greater involvement of applied social scientists in the process of public policy formation. Effective public policy requires management of the evolving system, and effective management requires an understanding of the dynamics of the system. But even more, it depends upon organizing our institutions to direct the system to achieve desired goals rather than accept whatever pattern of organization evolves. An essential input to the system is organized intellectual effort directed at institutional innovation.

In the modern situation, instituting the political economy takes on new meaning *for it is implicit in the scientific industrial system that it at once reduces man's dependence on nature and increases his dependence upon his fellow man.* Breimyer contrasts the industrial and primitive economies. "The primitive is an economy of nature, the industrial an economy of man. The limitations as well as opportunities are tied to nature in the former, man made in the latter. Whether a primitive economy turns out to be good or bad depends upon the bounty or niggardliness of nature—including the native endowments of the aboriginal population; the achievements of an industrial economy are the outcome of the wisdom or the baseness of civilized and educated man" [6, p. 685].

A Motor For Institutional Change

Our fund of ideas about economic dynamics in the industrialization process pretty much dates from Adam Smith's discussion of the pin factory. A basic feature of that innocent precursor of General Motors was the specialization of work roles which takes place in the production and distribution of (1) consumer goods, (2) capital goods, and (3) scientific and technical knowledge. But whereas Smiths example referred to the small scale production of existing consumers' goods—the pins—the greater meaning in the modern context attaches to producers' goods, scientific knowledge, new products, and merchandising. Newly created capital goods and techniques are substituted for existing skills, labor and equipment, rendering existing ones obsolete or of reduced value. The incentive for investing in new technology is the promise of reward [23]. In Smith's idiom the reward came from increased productivity. Today we grant that market advantage (and even tax advantage) can be equally attractive. We can only hope that in most instances there is some addition to productiveness. But, in any case, the result is to alter the level and distribution of incomes, wages and relative prices; also to make a new scale of enterprise appropriate and to create incentives for new patterns of coordination. A new pattern of external effects likewise results, replacing the accustomed pattern, creating an incentive for the development of new institutions of control and protection which are formed in social and political interaction. As a result of experience with new work roles (and locations), new products, advertising, etc., new ways of living evolve, influencing preferences and values. All this creates new incentives, a new round of investment in technology and further specialization. And, in this process a new organization of the political economy emerges.

Although the dynamics of modern society are basically expressed by the process described above, and we need to understand the policy problems associated with them, we must also take care not to become obsessed by technology. The essential derived problem involves social organization, not technology. Veblen and other institutional economists have been quite right to be concerned with the relationship of technology to the institutional organization of society. Nevertheless, the familiar notion that the major problem of society can be stated as institutional lag to technological possibilities seems to involve misplaced emphasis. Institutions are not just a drag on the economy. They represent the efforts of man to organize to achieve a large number of goals, not simply to get more material goods. Technology is a product of institutional organization just as institutional organization is a product of technology.

Adjusting the "Self-Adjusting Market"

Polanyi argues that the liberal state was a creation of the self-adjusting market, and the key to the institutional system of the nineteenth century lay in the laws governing the market economy [19, p. 3]. The founding institutions of the American political economy were based on the concept of a political economy consisting of the self-adjusting market and only sufficient government to protect property and enforce contracts. Jefferson envisaged a system with no concentrations in either economic or political power, with competition among equals in the open market eliminating the inefficient and minimizing the concentrations of power. This arrangement was believed to provide material well-being, foster individual freedom and promote equity.

In considering the evolution of the American political economy it is instructive to consider two modern extreme concepts of "ideal" social organization. The first concept puts emphasis on the self-adjusting market and is characterized by the social goal of maximizing total income of the society. The second would protect the individual and society against all adverse effects of change and is characterized by the goal of maximizing social integration (or minimizing alienation). The first holds that, leaving aside such refinements as second best and optimum growth models, if the economy always meets the marginal conditions necessary for the optimum allocation of resources and at the same time maximum technological advance obtains, incomes of the population will be maximized and this represents the best of all possible worlds.

The second concept of an "ideal" society would maximize social integration and is described by Olson as follows: "The degree of integration tends to increase with the extent to which a set of individuals form a 'community,' and would be nil in a situation in which a set of individuals had no social structure, common values, or institutions. It would be high in a situation in which everyone in a society was tied into the social order by bonds to a wide variety of associations, in which social structure was elaborate, in which common values, norms, and institutions were cherished, where individual roles were well understood, and where mechanisms of social control were well developed. The number and degree of group associations and affiliations, and degree to which behavior is institutionalized or organized, structured, and regularized, tend to be very high, if not indeed at a maximum level in this ideal society" [16, p. 112].

Olson [16] argues that these two models are polar opposites—that the achievement of one would be a nightmare for the other. For to adjust immediately and optimally to every possible change in technical opportunity, as in the income-maximizing ideal, would involve an incessant movement of the factors of production, including labor, not only from firm to firm but from place to place. To achieve this ideal, all group ties would be discouraged, including family ones. By contrast the integration maximizing ideal would lead to economic stagnation, for without changes in work roles there can be no economic growth.

But, of course, neither "ideal" comes close to expressing the full range of human values and goals. Perhaps we should introduce another model which would identify the characteristics necessary for each member to achieve the maximum of his human potential [9]. A part of the policy it is a benefit which cannot be captured, a cost which need not be borne, or a cost or benefit that is not perceived by the decision maker.[1] Abstractly, the problem created by external effects is that those things that each *individual* takes into account in making decisions are so structured that the sum of the decisions do not result in a performance acceptable to the society.

The ideal of the self-adjusting market promised a system of interaction that would coordinate economic activity leading to a desirable product mix in terms of the preferences of consumers. But this begs many essential policy questions. In order for the system to work, institutions of property and control have to be established. And these institutions determine what has to be taken into consideration by individuals and organizations in their economic actions. Much of the conflict of interest in the society is "settled" in the political determination or acceptance of these rules which determine how the desires and preferences of different members of the community are counted. They determine who may benefit from the system and who may not.

New technology, changes in extent of the market, etc., create potential benefits which cannot be captured and costs which need not be borne by firms as currently organized, with existing rules of property and control. Firms respond by attempting to adjust their boundaries of control to gain the potential benefits and to protect themselves from costs imposed by others. And the new pattern of external effects creates the possibility of benefits from new definitions of property rights.[2]

It is the protective institutions which determine to what extent the effects of new technology are internalized. They determine the incidence of the costs of technological displacement. They determine to what extent a firm can protect itself from what Schumpeter called the process of creative destruction, which is the ultimate discipline of the competitive market. It is probably true that no entrepreneur or worker ever exposes himself to marginal return valuation if he can avoid it. The prospects for labor are especially dismal if it is the single factor forced to bear the cost of adjustment [6].

The adjustment to new situations is never simple. There are strong motives to protect against undesired consequences and to gain economic advantage. It is the interaction of these motives with changes in technology, etc., which explains much of the change in the organization of the political economy. It is in this interaction that new institutions are forged.

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[1] The problem of external effects applies to all organizations of the political economy, not just firms and households.

[2] Demsetz argues that ". . . the emergence of new property rights takes place in response to the desire of the interacting persons for adjusting to new benefit-cost possibilities. . . Property rights develop to internalize externalities when the gains from internalization become larger than the cost of internalization" [8, p. 350]. In his stimulating Fellows lecture, Schultz seems to express this same notion, that there is an equilibrating process which makes it possible to explain institutional changes in terms of the economics of supply and demand [22]. I am concerned that adopting this approach runs the danger of being misunderstood as an apologist for the established order.

Historically the emphasis has been upon the protective institutions which would maximize social integration. The Greeks and medieval thinkers were concerned with the conditions necessary for political and social stability. The medieval guild represented the ultimate in internalization of the effects of new technology by effectively giving the craftsman veto power over the introduction of any innovation. The system was extremely static.

It is Paarlberg's belief that our present rate of technological change exceeds the optimum point. He argues that "the relationship between the rate of technological change in a society and the general good that accrues to the society is in the form of a curve, with a low reading for a semi-stagnant economy, reaching a maximum at some intermediate rate of technological change, and taking on a negative slope when the rate of change exceeds some optimum point. This is contrary to the conventional view, held by almost all physical scientists, that the relationship of rate of technical change in a society and the general good resulting therefrom is positive, linear and steep" [15, p. 15].

I believe the shape of Paarlberg's curve is closely related to a society's capacity to deal with "external effects" of technological change through institutional innovation and compensating public policies. The rate of adoption depends upon the manner in which effects are internalized. Clearly we do not wish to return to the guilds and stagnation. And Hirschman argues that internalizing all effects to a central planning agency is likely "to result in an overestimate of the prospective losses; for it is the nature of most innovations that its beneficiaries are anonymous, inarticulate, and unaware of the benefits-to-accrue (they include among others the consumers that are yet unborn) while those who stand to lose from the innovations are highly vocal vested interests" [13, p. 61].

There are serious external effects, including those related to social instability and community development, that are at least partially outside the accounts of policy makers because they do not have useful measures of them or do not perceive them as within their responsibility. Environmental pollution is an example of a class of serious problems that derive from the introduction of new technology and have effects that are not properly internalized to a decision unit. Some forms of pollution are now so serious that they threaten our survival by triggering irreversible destructive processes in the environment. Every new technology creates the potential for a new pattern of external effects.[3]

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[3] Let me illustrate some of the elements of the problems of the interaction of in-

Aside from the problems of obtaining evaluations of biological relationships, policy issues involve the assignment of rights. For example, how should we approach the problem of river pollution? The river could be sold to a private corporation. According to our understanding of private property, the owner would then act as a broker between the alternative users of the river, weighing each offer for its use in such a way as to maximize his profit, thus allocating the river to its highest use. This presupposes, of course, that the community would and could protect his right. Or, the river could be treated as communal property with the rights going to anyone who wanted to use it. This actually worked as long as incompatible uses were not competing for the river. The community might declare public ownership and prohibit specific uses of the river or set up a commission to regulate its use. In either case, use would probably be free. To prohibit use for industrial purposes would, of course, affect property values and prices of goods produced. The community could recognize communal rights and attempt to buy clean water by paying users not to pollute. In any case, a new technology, such as an atomic power plant, which adds much heat to a river, will require adjustments in the property

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stitutions and new technology with a simple story about mosquitoes. Once upon a time a farm community was bothered by mosquitoes and malaria. They did not know the relationship of the two and simply swatted the mosquitoes when irritated, for it was not worth the cost to control them. They next learned that mosquitoes were responsible for malaria. Each farmer could gain some protection by screening his windows, which he did. This had the unexpected effect of making the hardware dealer a relatively wealthy man and thus a man of political power. However, the mosquitoes continued to bite. New knowledge was acquired that linked the number of mosquitoes to the amount of stagnant water. It was determined that if each farmer volunteered 20 hours in the spring, the breeding grounds of the mosquitoes could be drained and the mosquitoes reduced by 90 percent. A new organization was developed, called the Voluntary Mosquito Control Association. It soon became clear to the least ambitious of the farmers that he would be better off by not participating, for he would get the benefits without working. The burden was thus increased on the others, and the process continued until the association failed to function, even though mosquito control was worth far more than 20 hours of work to each farmer. They next attempted a solution by introducing a local ordinance, declaring stagnant water a public nuisance and requiring all land owners to eliminate it from their property. Unfortunately, half the stagnant water was on the land of one farmer. He argued that it was unfair and illegal to impose such cost on him. Since he was also the hardware dealer, and by that time chairman of the township committee on resolutions, the proposal was bottled up in committee. The township board then voted to support a control program through general taxation. This worked well within the township, but, unfortunately, mosquitoes were found to migrate from the next township which had no control program. After several years, a two-township control district was set up and a farmer was granted a contract to control mosquitoes. At this time the new technology of DDT was introduced and DDT was used to kill the mosquitoes. But DDT also found its way to earthworms; and from earthworms to a common bird that was eaten by the cats of a village in the next county. The cats all died, resulting in an invasion of rats which bit the villagers and spread the plague. The villagers then came to understand the damage to them from the use of DDT but had no institution for protecting themselves from the ill effects.

rights since heating the water of the river has not previously been a source of pollution.

The policies selected will make a great deal of difference to the quality of life of the community and to the distribution of income. The choice of policy is complex, requiring a high level of critical analysis. An evaluation of the trade-offs and the full effects of any rules adopted would be required.

The Emerging Political Economy

The Bureaucracies.—If I were called upon to name the emerging political economy after its most obvious characteristic, the name would be bureaucracy. Individuals seek protection through associations—the labor union being a notable example. Trade associations, professional associations, cooperatives, and all kinds of other special interest organizations exist to advance special group interests. The government in attempting to respond to the needs of society develops bureaucratic agencies. And we institute through government a variety of protective rules and income transfer laws, usually interpreted and administered by large agencies. Among these are the rules for group participation in modifying the outcome of market interaction. And perhaps most characteristic of the present age is the bureaucracy which in fact controls and manages the giant corporations.

In our concern for the growing discrepancy between potential and achieved quality of life, we must examine the behavior of bureaucratic organizations. A bureaucracy has among its characteristics the following: It has a life of its own—the incentives perceived by its management may be quite independent of the intentions of its "owners," be they stockholders, legislators, citizens, or members; it spends much of its energy in protective tactics designed for a survival independent of performance [18]; in a changing society, the bounds of control of a bureaucracy frequently become inappropriate to the problems with which it is intended to deal; it is frequently structured to a narrow interest and responsibility, but with capacity for extensive external effects; and it creates positions of extensive power and control, often undisciplined.

Yet, organized technical competence is indispensable to the modern political economy; technology, specialization, and essential protection of society's interests dictate it. We must rethink our ideas of instituting bureaucracies to make them more responsive to the needs of society.

The Corporation.[4]—Berle reminds us that the founding fathers specifically denied the federal government the power to create corporations, because of concern for the potential concentration of power inherent in the corporation [3, p. 76]. Their concern was prophetic. By 1967, the 100 largest corporations held 48 percent of the assets in manufacturing in the U.S. [1, p. 92]. And Berle argues that "if a rather larger group is taken, the statistics would probably show that about two-thirds of the economically productive assets in the United States, excluding agriculture, are owned by a group of not more than five hundred corporations" [3, p. 82]. The control of these giant corporations is in the hands of the managing bureaucracy, with 100 or so trust departments of banks managing very large stock holdings for individuals and pension trust funds with power to check the performance of the management [3]. Surely this represents the greatest concentration of economic power in history. What institutional innovations are needed to insure that this power will be exercised in the public interest?

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[4] My debt to Galbraith [10], Berle [3], and Mueller and his staff [1] for much of the material used in this section is gratefully acknowledged.

The bureaucracies of the large corporations follow a number of practices (protective institutions) which significantly modify the outcome of the market. They avoid uncertainty and improve vertical coordination through vertical integration and contracts, thus substituting administrative coordination and negotiation for spot market coordination. They have the capacity, within limits set by monopolistic competition, to manage prices. They avoid the uncertainty of the capital market, at least to some extent, by assuring a large part of financing from retained earnings. This gives them significant advantage over small firms. The uncertainties of the labor market are reduced by negotiations with labor unions (thus individual workers avoid marginal evaluation of their effort). Product markets are modified by negotiated contracts with buyers, especially with the government, and by managing consumer demand through advertising, promotion, and product design [10].

According to Galbraith [10], a number of the needs of the corporate bureaucracy are also provided by the state. The state trains technicians and spends large sums on technical research valuable to the expansion of the corporation and the economy. And the state reduces risk to the corporate bureaucracy by providing programs for price stabilization and growth; planning is more successful with a small but regular rate of inflation.

A discussion of the consequences of the developing pattern of larger size firms is beyond the scope of this paper.[5] Let me comment, however, that the evidence is that for most manufacturing industries, the largest firms are much larger than necessary to achieve the economies of scale available in the production process [1, p. 63]; that fostering large size is an unnecessary and unreliable method of stimulating inventive activity [1, p. 67]; and that much of the advantage of very large size relates to financial and promotional activities [1, p. 69].

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[5] Actually we have no satisfactory evaluation of the performance of the American industrial complex. The test would have to be in terms of comparison with systems controlled by different sets of rules We get some insight into the complexity of the necessary analysis from Sosnick [25], who has recently outlined for us his criteria for effective competition by listing 25 conditions he considers avoidable and undesirable in a market. It would be instructive to test existing markets against his list. He fails, however, to inform us of the necessary changes required to institute markets

We are only beginning to understand the implications of the institutions associated with product differentiation and promotion. They are clearly very significant protective institutions for the firm. Advertising, offering very great economies of scale, is an incentive to larger size and an effective barrier to entry by small firms. And advertising creates a new property in the form of the *image* of the product. Advertising represents about 10 percent of the value added by consumer goods manufacturers [1, p. 69].

Advertising has another dimension in the emerging political economy, since it is designed to change preferences and has substantial effects on the content of the mass media. The concept of the "good life" and acceptable behavior for many Americans is defined in their many hours of exposure to television sponsored by the large advertisers. This is an external effect of firm activities that is of critical importance to the quality of life.

Organization and Control of Agriculture

It is probably true that not more than 12 percent of the value added in the production and distribution of food and fiber in the United States is contributed by farming. The manufacture and distribution of farm inputs, much of food processing, and most of food retailing is done by large corporations or associated groups. The processes of scientific industrialization will continue to create profitable specialization that will result in more activities of food production moving to non-farm occupations and large firms.

Food production and distribution is a vertically coordinated process organized by a complex set of behavioral rules. Nevertheless, it may be of some value to simplify the description of the system in order to get some perspective on the policy issues. For each industry of the sector, the following organizational characteristics can be identified: the extent of horizontal concentration in firm output; the extent of horizontal concentration and bargaining institutions of labor, i.e., collective bargaining with or without government sanction, voluntary or compulsory membership, with or without arbitration; and the relationship of ownership and management—corporation, cooperative, individual proprietor, etc. Activities are vertically coordinated between and within industries by competitive mar-

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to meet his criteria and the complex effects of such changes in institutions. I leave this to future professional discussions.

kets, negotiation without contract, negotiation with contract, administratively by private or public agency, or some combination or variation of these. Policy analysis is concerned with predicting the performance associated with the various sets of formal rules facilitating or restricting the development of particular combinations of these vertical and horizontal characteristics.

Within the agricultural economics profession, the basic issues of industrial organization and regulation of competition have generally been treated separately from those of price policy and income supports. While the issues of efficiency, equity, and control were being argued in terms of government regulation of farming, a major revolution in the control and coordination of the food and fiber sector has been under way.[6]

As I interpret the political and economic trends, we can expect the specialized protective institutions of price and income supports for farmers to become less important, but at the same time less reliance will be placed on atomistic markets to coordinate activity and evaluate contributions. Laws will be adopted to facilitate collective action by farm labor and farmers. The ultimate form of vertical coordination and control of farming is uncertain. Helmberger suggests "there might be considerable merit in allowing entrepreneurs and competition among them and the competition between conscious and unconscious coordination to specify the best configuration for us" [11, p. 25]. But, this begs the policy question—competition under what rules? The outcome—and thus the performance of the system—will depend upon a large number of institutions, many of which evolved without consideration for their effect on the control or performance of agriculture. And a variety of institutions can be developed that would modify the outcome of the competition among alternative methods of organizing the sector.

For example, a major factor determining the control of farming will be access to capital. The giant corporations have great advantages over other enterprises in access to capital, including large quantities of retained earnings. Would it be a desirable part of agricultural policy to have a 100 percent tax on all *retained* earnings of large corporations? Do price support programs contribute to a division of ownership of land and management in agriculture by increasing land values? Would the development of improved institutions for small corporate ownership, including an effective market for the stock, facilitate control of farming enterprises by those best qualified to manage?

We know that the needs of the industrial system and of consumers create demands for improved specification in product characteristics and timing. Atomistic farm product markets, unregulated as to price or quantities marketed, are generally unstable and unreliable as to supply. The planning needs of individual firms can be met through vertical ownership or by contract. It has generally been assumed that contracts involve direct negotiation and dispense with the market as an allocation mechanism. This is a narrow view of the market. A national market in deliverable forward contracts—using a computer and direct national input through a teleline system, with transportation calculations and brokerage built into the system—could conceivably be established. This would provide the needed coordination and reduce the stimulus for vertical integration into farming, while providing the advantages of a competitive market without the price uncertainty. However, such a market system is not likely to simply evolve. It would have to be instituted through government action.

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[6] See the excellent set of papers from the joint seminar of the North Central Regional Policy and Marketing Committees entitled "Agricultural Organization in the Modern Industrial Economy" [15].

We know it is unprofitable for individual producers in atomistic competition to promote their products, because they cannot capture the benefits. Advertising, in this case, is a collective good for all those producing the particular product. In contrast, the large corporation selling differentiated products can capture the benefits of promotion. The food analogs—the new substitutes for traditional foods—are developed and produced by large corporations (usually based upon research done at least in part at public expense). Given the power and economies of modern merchandising, it is not unreasonable to assume that an *"inferior"* analog would win in competition with a *"superior"* traditional food. Is it possible that the transition from farm to factory production of food will be accelerated and that consumers will end up with less desirable foods because of the relationships of market structure and advertising? This problem is usually seen only as one involving the freedom of farmers to join or not join a collective association for promotion. But it is more. Where does the public interest lie in this case?

These examples only illustrate that the organization and control of agriculture will be determined by a wide variety of rules of the political economy, although obviously affected by the changing technical relationships.

Technological Displacement and Community

The problem of the people left behind—as so aptly identified by the Commission on Rural Poverty—remains one of the most perplexing problems of political economy. How do we explain and deal with poverty in an affluent society? The very nature of the process of scientific industrialization is to make existing job roles obsolete. The problem has been clear in the United States, with its depressed areas and unemployment coexisting with inflation. It has been the most significant rural adjustment problem in the transition from an agrarian to an industrial society. And millions of people will continue to be affected by the problem in the United

States, some through displacement from farming and many through displacement from other types of employment. In the newly developing areas of the world, the problem is overwhelming. With the newly developed technology in agriculture, tens of millions of people are threatened with technological displacement with little prospect of rapid and effective integration into the economy unless this problem of social organization is solved.

The following quotations illustrate something of the nature of our failure in defining this problem in U.S. agricultural policy.

According to the National Advisory Commission on Food and Fiber, "Overall, the United States has had a highly successful agricultural development policy . . .

"More than anything else, the Federal farm programs of recent years have been attempts to equitably distribute the fruits of agricultural progress to major groups of commercial farmers and consumers. Price supports and income payments have tried to permit farm progress, with its benefits for consumers while retaining some of the gains for farmers" [14, p. 11].

At the same time, the President's National Advisory Commission on Rural Poverty reports that "It is a shocking fact that in the United States today, in what is the richest nation in history, close to 14 million rural Americans are poor, and a high proportion of them are destitute. By their poverty they are deprived of freedom to share in our economic abundance.

We can no longer permit public policy to ignore the rural poor. For if we do, we shall see a continuing movement of rural people to our central cities. As the summer of 1967 illustrated, the slums and ghettoes of the city breed hatred and violence, which is no solution to the problems of either city or country" [20, p. 3].

The contrast in these quotations indicates that our policies of fostering technological development in agriculture and supporting farm prices have had extensive external effects. As too often seems the case, the policy problem was defined and executed in such a way that frequently the most privileged received the most help. Agricultural economists, of course, knew that any program supporting prices would distribute benefits according to output and thus be highly correlated with wealth. Witt reported such an analysis as early as 1942 [26]. And we know that most of the value would be incorporated into the fixed factor, land, thus accentuating the problem. Also, income supports based on historical allotments have essentially the same effect. The marginal farmer and the farm laborer, those most affected by technological displacement, are helped very little, if at all, by these programs and may be hurt to the extent that the programs stimulate more rapid adoption of new methods and capital that replace labor. These programs, appropriate to another period in our history, have long since been obsolete.

We have tended to consider technological displacement as a problem of individual adjustment for those who are displaced. Economists tend to emphasize programs to facilitate mobility of the individual as a worker. We have had a number of institutions to ease the adjustment or to protect individual workers. On the other hand, some of our accepted protective institutions have the effect of making it more difficult for those who have been displaced—those most in need—to participate in the economy. Examples are entry restrictions of unions, pension schemes that make it uneconomical to hire older workers, minimum wage, and a host of credential requirements unrelated to performance.

Our protective institutions have been far from satisfactory in providing the positive values associated with social integration and human development. Our associations and governmental units have tended to become large bureaucracies, often contributing to rather than reducing alienation. Our welfare programs have tended to be degrading and alienating, rather than integrative. Even many of our schools, society's greatest hope for fostering human development and socially productive attitudes, have become large, impersonal alienating organizations. Communities in both urban and rural areas continue to be disrupted as people migrate in response to market and welfare incentives.

The problem has been accentuated by a host of obsolete institutions and organizational boundaries among our local governmental units. An example is the property tax as a major source of revenue for education and local government. It belongs to another era. In combination with several related institutions, it is contributing to a process that is destroying many communities and disadvantaging thousands of young people.[7]

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[7] Let me illustrate. New technology in cotton results in a migration of some poor people from the south to a northern city. The new arrivals settle in an old but respectable area of the city. They send their children to the school. Since they came from an area with little schooling, the new children increase the cost of maintaining existing standards in the school. The school adminisrators attempt to meet the new needs by program changes requiring additional money. The only source of additional money is the local property tax, a tax well suited to an agrarian society, but obsolete today. The tax election passes the first time, but provides insufficient revenue to maintain the quality of the school. In order to get better schools and to avoid the high taxes of the city, some of the older residents of the city move to suburbia. New migrants move into vacated homes now owned by corporations interested in maximizing profits. The suburbanites put pressure on the legislature to build highways into the city in order to get them to their jobs in the city. This adds to the city budget and at the same time takes property off the tax rolls. Since the road went through the poorest part of town to save money, the demand for low cost housing increases. Property taxes go up. The landlords and home owners find that any improvements they make in their homes cost them large sums in additional property taxes so few improvements are made. The atmosphere of the city deteriorates. More of the middle class desert the city. Property taxes go up. Slums develop. No increased property tax to support schools can be passed because it imposes a high burden on low income people and those who put highest value on education have left the city. The social fabric of the city also deteriorates. The boundaries of the city are fixed and it cannot save itself. A bill is introduced in the state legislature to get state-wide support for

The external effects involved in displacement and more generally in the pattern of human settlement have been largely disregarded. The environment of the community—including the attitudes of its people—is a collective good. A quality environment requires collective action. New planning concepts and procedures for collective decision making must be developed. The political economy of community development has been seriously neglected.

Income Distribution and the "New Property"

Many of our values supporting the institutions that specify claims to income were developed in an agrarian society where the property rights to land were very important. If no ownership rights exist in the land, there is usually inadequate incentive for a farmer or hunter to husband the land [8]. In an agrarian economy, the man working the soil saw a direct relationship between his sweat and his return. And, in an economy close to subsistence, it was important that this connection be ever maintained. Thus, the habit of thought that income received was earned and was rightfully due had high social utility. The equity issue arose only in regard to the distribution of land. In the modern economy, however, many of the protective institutions represent claims upon income or can be used to gain income advantages with little relationship to productivity.

Whereas in the agrarian economy much of the increased productivity was imputed to the fixed factor land, today it is imputed to a wide variety of intangibles or vested rights—the new property—including corporate stocks, strategic positions in corporations, tenured positions, union memberships, licenses, quotas, brand names, educational credentials, as well as property rights in natural resources. And, of course, much of the increased productivity accrues to those with special skills and information—those in whom a part of our accumulated knowledge has been vested.

It has always been true that productivity depended upon technique. However, in the modern industrial economy, knowledge and organization have become the *dominant* factors in production. To a very large extent, the wealth—or productive capacity—of the U.S. economy lies in the accumulated knowledge of the society. It is clearly urgent that we modify our institutions to achieve a more equitable sharing of the increased productivity, based upon our inherited knowledge.

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schools and eliminate the property tax. But the chairman of the tax committee, a suburbanite of long standing, refuses to allow the bill to be debated. Finally, in frustration, the city burns.

The property tax is having the same effect on the rural community. The educationally disadvantaged in the United States reside in rural areas and the inner city. They will continue to be disadvantaged as long as the property tax remains the only source for the quality differential in education. And the consequences will be felt in the quality of life of all of us.

The legitimacy of the present system is being seriously challenged and is a factor in the political and social instability we are experiencing. Greatly increased productivity is in the offing. The rules of the game give great differential advantage in access to this increased income, and everyone more or less has come to recognize that the increase is not due to the anguished sweat of individual workers or the astuteness of management, but to the level of technical capacity in the total system.[8]

We should be reminded, of course, that income distribution and level and quality of output of the political economy can never be separated. For the pattern of institutions which determines the distribution of income also structures the incentive system. That is, income distribution and levels and quality of output (including social stability, etc.) of the total political economy are joint products. This is not to say that we cannot have both greater output and more equitable divison of income, for we surely can. Our problem is to develop the appropriate institutions.

There is much evidence that many Americans seek a more equitable system. The sense of community has resulted in literally hundreds of protective rules, organized programs of grants[9] and related taxes intended to help the relatively disadvantaged. But many of the programs and protective laws have been ineffective, often self-defeating, and sometimes destructive of their intended purpose.

Without significant institutional modifications, the problem will likely worsen. Even with grants and income taxes, there appears to have been little change in income distribution in the United States in the last 25 years. This means that the absolute differences in income are becoming much larger. With more and more workers organized, with greater vulnerability of the system to organized groups, and with more large scale firms, the struggle of each group to get its "fair share" will make it even more difficult for the unorganized and unpropertied to share in the increase.

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[8] Ayers argues that economists use the concept of productivity and the theory of marginal productivity (including the conclusion that "Free competition tends to give labor what labor creates, to capitalists what capital creates, and to entrepreneures what the coordinating function creates") as an ideological support for the existing system of income distribution [2, p. 3]. I agree with Hirsch, however, that this is an unfair attack on economists [12]. Yet, the habits of thought associated with the marginal productivity theory do serve to support existing patterns of income distribution and impute a meaning that the theory never justified. We talk of wage increases being justified by increases in productivity and imply that differences in incomes received by those with different levels of education represent differences in contribution. It is also clear that some economists and many members of the public believe that any income distribution which obtains from a "free" market does reflect the patterns of contribution and, thus, the incomes are ethically justified.

[9] Grants have increased from something like 3 percent of GNP in 1910 to something between 10 and 20 percent today, depending on definition. Grants are an important aspect of the evolving system; hopefully, understanding of their role will be enhanced through a new association for the study of the grants economy [5].

We need to find an effective way of legitimizing a flow of income to the relatively disadvantaged and to make our intangible property socially more beneficial. Grants are useful as incentives for participation in activities beneficial to individual development and community. However, the creation of new rights would have significant advantages over grants as a means of providing access to income.

One of the problems of the present welfare system is that, notwithstanding the general question of equity, once income is received it is considered earned and deserved by the receiver. And taxpayers are resistant to giving up their "hard earned" money and have it transferred to those without "legitimate" claim.

Let me suggest for *study* an alternative which meets some of the needed characteristics. It is anything but a complete idea.

A new organization would be created—let's call it the U.S. Inheritance Mutual Fund. USIMF would be an independent mutual trust organization which would own, in the name of the citizens, certain income earning assets. It would own the rights of all scientific discoveries, inventions, and commercially exploitable ideas which derive from the work of scientists and technicians supported by government funds. The federal expenditures for scientific research and development in the 1960's will be in the range of $150 billion. And the rights to certain past technological developments would also be awarded to USIMF. The fund would not itself exploit the processes commercially but would license their use. In addition, the rights to certain of the existing public properties would be vested in the fund. In any situation where the government, for whatever other purposes, creates a monopoly or special privilege or windfall gain, the access to that monopoly or privilege would be competitive bidding and the rights to the income obtained would belong to the fund. For example, commercial TV channels would be offered to the highest bidder meeting specified performance criteria. All inheritance taxes would also go to USIMF. The trustees of USIMF would be instructed to transfer as much of the fund's wealth as would be prudent into stocks of American industry. The Congress would write the "will" specifying that all citizens had inherited the wealth of the fund and would share in it according to specified criteria of age and family composition. The amount of the payment each month would depend upon the earnings of the fund.

I make no special plea for this particular institutional innovation, although I believe it suggests some interesting possibilities. We do not have a very good idea of the potential effects of such an institution on incentives [17]. It should promote respect for self and the American system. It eliminates some of the bureaucratic problems in the present welfare system. It would not stimulate migration to gain welfare advantages. If, in instituting the innovation, political trade-offs could be made to eliminate many of the discriminatory and obsolete protective institutions and this would be complemented by a positive approach to the problems of community and human development, we might just move in the direction of the "best of all possible worlds."

On the Role of Applied Social Scientists

Public policy is concerned with changes in the formal rules that regulate the activities of members of the society. These rules specify rights and obligations. By and large, the social science disciplines have taken the position that these rules cannot be judged. They are the province of ethics and moral philosophy. But surely the rules of the political economy must be judged, and I believe that applied social scientists have a major role to play in the process.

Alternative rules lead to different consequences. It is the province of applied social science to understand the complex social systems and predict the consequences of alternative sets of rules. The purist may argue that as scientists, the appropriate role is to simply identify relationships and specify alternative outcomes leaving the value judgments to the political process. Ultimately, in a democratic society, the judgments of value are and should be made in the political process. But, this does not interpret the role of applied social scientists. Both the issues selected and the variables included in analysis involve value judgments. So, like it or not, the social scientist involved in policy analysis becomes a participant in the process, bringing his value judgments with his analysis.

The variables considered relevant in any policy issue will clearly affect any predictions made. To a large extent, the variables considered relevant are determined by the discipline of the social scientists. And, the very high levels of specialization by the different social science disciplines bring a narrow perspective to their analysis, greatly reducing the effectiveness of social science in policy formulation. A part of the present problem in U.S. public policy is the failure to consider the essential variables involved in our critical policy issues. For example, the sociologist's basic question concerning the factors that hold the society together must be considered along with the questions about *economic* growth.[10] Too many of our socio-economic policies have effects quite unintended by the policy makers.[11]

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[10] Senator Mondale and several other senators have introduced a bill to be known as the Full Opportunity and Social Accounting Act which would provide for a Council of Social Advisors, presumably to parallel the Council of Economic Advisors. Among other activities the new council would be expected to interpret social indicators to policymakers [16]. This is a welcome proposal but I believe the two councils should be integrated, with a requirement that serious attention be given to the development of a unified report that would provide a balanced evaluation of the trends in the quality of American life.

Prediction of consequences depends upon description of the system, which can be approached as an activity of pure science. In this connection, I have been wondering if the habits of thought imposed by our equilibrium models may not restrict an understanding of the complex evolving system. Buckley contrasts equilibrium, homeostatic, and complex adaptive models, describing the latter in part as ". . . open 'internally' as well as externally in that the interchanges among their components may result in significant changes in the nature of the components themselves with important consequences for the system as a whole . . . True feedback loops make possible not only self-regulation, but self-direction or, at least, adaptation to a changing environment, such that the system may change or elaborate its structure as a condition of survival or viability" [7, p. 490]. Buckley argues that the socio-cultural system more closely fits the complex adaptive model. I do not believe the dynamic system can be described by equilibrium models or theories of advantage. We need also accept the fact that the system is too complex to ever completely specify, and we will have to live with a fairly high level of uncertainty as to outcome of the dynamic system.

Description of the complex adaptive system and prediction of the flow of consequences from alternative policy proposals, in my view, does not describe the full role of social scientists in our democratic society. I believe a substantial effort should be spent in diagnosis of society's ills and prescription of institutional innovations to deal with the problems [24]. Prescription involves art as well as science. We need to develop the skill to create the concepts of new institutions that will serve the purposes of society. For social scientists of this persuasion, this means being a social critic. *The universities should nurture the social critic and support extensive dialogue on issues of public policy, as should the academic professional associations. It is an essential input to the development of the emerging society.* And university professors need much more aggressively to perform this essential social function. We need to bring organized trained intellectual resources to this task. Among other things, we must learn to institute effective task forces to deal with the larger, more complex problems of public policy. Reform cannot be left to the uninformed.

This role is, of course, made more difficult, and at once more important, by the fact that there is no simple harmony of interest in society. The social scientists can do much to explain policies of long run mutual advantage and this has not been fully exploited. However, it is seldom that significant changes in rules would receive unanimous vote of the population, which is the implied requirement for Pareto optimality. The role of social critic is made all the more important by the domination of society by only partially disciplined bureaucracies and by the extensive concentrations of power with strategically situated vested interests. Our forefathers emphasized the need for a balance of power, and in this the university has a very important role to play.

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[11] Would it not be desirable to institute an independent agency of applied social scientists, responsible directly to Congress, to provide an effective and continuous evaluation of the acts of Congress? I believe so, although this would put some power of government in this agency because information as well as power makes policy.

In our society, research and development means, by and large, technical research and product development. We have failed to convince the policy makers of the necessity for extensive research and development designed to improve the social institutions. Thus, our first task is clearly educational. We must teach students and the public about the social consequences of the evolving scientific industrial system and the necessity for orderly reform.

The old habits of thought, which assume that leisurely processes of judicial and legislative review are adequate to meet the opportunities and problems created by newly developed technology, are obsolete. We know the time between a scientific discovery and its application is steadily declining. The rate of technological innovation could increase enormously. A system for anticipating the negative effects of a new technology is sorely needed. We cannot afford to wait for the problem before solving it. *The institutional innovations will have to be developed as joint products with the technology.*[12]

Implicit in my argument is a call for a reorientation of some of the activities of agricultural economists. Just as the work roles of others in the economy must change as the political economy evolves, so it is with our own. Bishop was properly concerned that "To continue on the road we have been traveling will likely lead us into the role of publicly subsidized consultants to the corporate farms and marketing firms of the future" [4, p. 1007]. But I believe agricultural economists come as close as any group to having the background and attitudes needed for effective participation in the research and extension activities required for evaluating existing institutions and developing improved institutions. We have always been oriented to helping people solve their problems; today, the critical problems involve institutional reform. We may be especially effective in helping to vitalize the institutions of the rural communities.

We need to re-examine our training of graduate students. Can we train them so that they will develop the unified approach to social science so essential for work in public policy and community development? We are not doing it now. And is it necessary for each of them to be trained as applied mathematicians and formal systems model builders? Are there not those who would better study ethics, law, and the other social sciences as preparation for institution building rather than model building? I believe we need both.

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[12] For example, there are special problems of allocating rights where a threshhold is involved. Suppose it were determined that x millions of tons of DDT could be used in the world with no adverse effects and that 2x would kill most of the fish in the ocean. How ought the right to use DDT be allocated under these circumstances?

Our technology has liberated us from the base tyranny of the environment, but we have not adjusted to the new freedom with its implicit premise that a meaningful life for all the members of our society is limited only by our will and creativity in structuring our institutions.

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The International Encyclopedia of the Social Sciences: A Review Article*

JAMES P. CAVIN

ACCORDING to the editor's introduction, "The *International Encyclopedia of the Social Sciences* is a completely new reference work, designed to complement, not to supplant, its predecessor, the *Encyclopedia of the Social Sciences.*"

It is obvious that an encyclopedia cannot be reviewed in the conventional sense. Indeed it can be argued that a review is superfluous. Congenital users will consult it anyway; nonusers will ignore it. However, having accepted the responsibility for a review, I must proceed forthwith. In view of the interests of this Association and the limitations of space, the focus is mainly on the economics component of these volumes. When referring to articles, I have generally cited the volume and the author. I have not given the author's academic or other affiliation except when from a country other than the United States.

With the social sciences becoming increasingly quantitative, it seems appropriate to begin with a few facts and figures. The *International Encyclopedia* contains 1,716 articles (including about 600 biographies) prepared by over 1,500 scholars—all but a few of whom are social scientists. It adds up to over 9,000 pages and about 8 million words. It fills 17 large volumes—the last being an exhaustive index. The delivered weight is 82 pounds. The enterprise is also substantial from the financial point of view, as evidenced by an initial outlay of $2 million by the publishers.

The simultaneous publication of all 17 volumes is an impressive editorial feat, particularly when one recalls that its predecessor was issued volume by volume during the years 1930 to 1935 [2]. The editor is David L. Sills of the Bureau of Applied Social Research, Columbia University, assisted by 7 associate editors and 5 special editors. The associate editor for economics is Albert Rees of Princeton. The special editors include Bert F. Hoselitz of Chicago, for economic growth, and Robert H. Strotz of Northwestern, for econometrics. Overall guidance was provided by an Editorial Advisory Board of 175 eminent scholars, under the chairmanship of W. Allen Wallis, president of the University of Rochester. Alvin Johnson—associate editor of the 1930–35 encyclopedia—served as honorary editor.

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* Sills, David L., ed., *International Encyclopedia of the Social Sciences,* 17 vols. New York, The Macmillan Company and the Free Press, 1968, xxx + 9,750 pp. ($495, the set).

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The planning and organization of both undertakings have a most interesting and illuminating history. Users of the present volumes can profit by reading the Foreword by Johnson, the Preface by Wallis, and the Introduction by Sills.

An important difference between the initial effort and this one concerns the scope of the social sciences. In the first version, the editor-in-chief—the late E. R. A. Seligman—admitted 7 disciplines to the realm: politics, economics, law, anthropology, sociology, penology, and social work. He also identified 4 semi-social sciences—ethics, education, philosophy and psychology—certain aspects of which were covered because of their increasing significance for social problems. Lastly, a number of sciences with social implications—biology, geography, medicine, linguistics, and art—were accorded marginal attention.

The *International Encyclopedia* embraces 10 disciplines: anthropology, economics, geography (in its non-physical aspects), history, law, political science, psychiatry, psychology, sociology, and statistics. The last field is not regarded as a social science *per se* but as a "critical auxiliary discipline" on which the social sciences are increasingly dependent. Emphasis is placed on the analytical and comparative aspects of the several disciplines rather than on historical and descriptive materials. The 600 biographies compare with some 4,000 in the first encyclopedia, but the new ones are generally longer and include a few living persons.

The basic organization is alphabetical—from Ability to Zoosemiotics—modified appreciably by the frequent grouping of several articles under one alphabetical heading. For example, 10 separate articles are grouped under Agriculture, 6 under Anthropology, 4 under Economic Growth, and 8 under History. These groupings are variable in nature and extent, and appear to reflect the considerable degree of autonomy enjoyed by the associate and special editors in organizing the contributions within their respective subject matter fields.

Essential to any encyclopedia is a good index, and here the editors have done about all that one could ask. In addition to a detailed general index of over 300 pages, they have provided an index of authors, an alphabetical listing of articles, and a classified list of topical and biographical articles. The latter are arranged under 29 headings, such as Anthropology, Econometrics, Political Science, and Sociology. To take one example, some 75 subject matter articles and 39 biographies are listed under Statistics. The user can see at a glance that he will find articles on the design of experiments, correlation, game theory, sequential analysis, Markov chains, and time series, as well as biographies of Karl Pearson, Abraham Wald, R. A. Fisher, G. Udny Yule, and others.

This is probably as good a place as any to note that the typography is excellent, the bibliographies exceptionally well presented, and the volumes lie flat when opened. These technicalities greatly enhance the usefulness of the encyclopedia. Typographical errors appear to be rare. There is one in Vol. 10, p. 452. Also, in Vol. 4, p. 351, H. L. Moore's middle name is given as Luddell instead of Ludwell.

A large proportion of the articles concerned directly with agriculture are included in the 10 groups under that heading (Vol. 1): "Comparative Technology," by F. H. Farmer (St. John's College, Cambridge); "Social Organization," by Charles P. Loomis; "History," by Wilhelm Abel (Göttingen); "Production," by Dale E. Hathaway; "Capital," by Glenn L. Johnson; "Labor," by Varden Fuller; "Productivity," by Zvi Griliches; "Marketing," by Herman M. Southworth; "Price and Income Policies," by D. Gale Johnson; and "Developing Countries," by John W. Mellor.

Land also receives considerable attention (Vol. 8). Two articles are grouped under that heading: "Economic Uses," by Marion Clawson, and "Classification," by L. Dudley Stamp (London School of Economics). Grouped under Land Tenure are "Introduction," by Daniel P. Biebuyck; "Agricultural Tenancy," by John F. Timmons; and "Land Reform," by Philip M. Raup.

Other references to agriculture, land, and related topics can be located readily in the general index. Since the articles under Agriculture total only about 60 pages and those on Land about 25, their appraisal can surely be left to the individual initiative of readers of this Journal.

Gale Johnson's article on price and income policies—which takes a rather dim view of the whole business—serves to remind one that this topic has become progressively less important as a focus of agricultural economics research in the United States. It seems clear that neither Congress nor farm groups will accept anything resembling a free-market solution; but neither will they accept stringent and comprehensive controls, such as those advocated some years back by Willard Cochrane [1]. As a result, we continue to lumber along with various rearrangements of the vintage mixture of price supports, direct payments, acreage allotments, land retirement, surplus disposal and import restrictions—with the probability that the land retirement approach will receive increased emphasis under the Nixon administration.

Two areas prominent in this encyclopedia, namely Economic Growth and Econometrics, should be of considerable interest to most agricultural economists. The four articles under the heading of Economic Growth (Vol. 4) complement each other exceptionally well. "Overview," by Richard A. Easterlin, develops the central theme that "economic growth is a creature of the scientific revolution." "Theory," by Gustav Ranis, has an historical emphasis extending from the classicial economists to the Harrod-Domar model and its variants. "Mathematical Theory," by Michio Morishima (Osaka University), gives special attention to the models of

Walras and Von Neuman. The last article, "Noneconomic Aspects," by Bert F. Hoselitz, special editor for economic growth, emphasizes the "social and cultural aspects of the condition of underdevelopment."

These four articles, together with a number of others—including that of Mellor mentioned above, "Capital, Human" (Vol. 2), by Theodore Schultz, and "Economy, Dual" (Vol. 4), by W. F. Wertheim of the University of Amsterdam—provide a solid introduction to the field as a whole. The last article contains an interesting summary of the theories of Boecke, the Dutch economist, and Geertz, the American cultural anthropologist, on the persistence of underdevelopment in the economies of a number of Asian countries.

Articles on, or related to, econometrics are abundant, to be found not only under the heading Econometrics, but under Statistics and Methodology as well. Only a few examples can be cited here to indicate the scope and nature of the contributions in these areas.

A comprehensive survey of the development of Econometrics (Vol. 4) is provided by Robert H. Strotz, the special editor for this field. Two articles that should be of particular interest to readers of this Journal appear under the heading of Demand and Supply (Vol. 4)—one, a theoretical article by Kenneth E. Boulding; the other, "Econometric Studies," by Karl Fox, who gives special recognition to the contributions of agricultural economists, including Mordecai Ezekiel, Elmer Working, Fred Waugh, George Brandow and Earl Heady.

To no one's surprise, "Input-Output Analysis" (Vol. 17) is handled authoritatively by Wassily Leontieff. Other articles include "Mathematical Programming" (Vol. 12), by Richard E. Quandt; "Simultaneous Equation Estimation" (Vol. 14), by Lawrence E. Klein; and "Distributed Lags" (Vol. 4), by Marc Nerlove. Four substantial articles will also be found under Time Series (Vol. 16): a general discussion by Gerhard Tintner; "Advanced Problems," by P. Whittle (University of Cambridge); "Cycles," by Herman Wold (University of Uppsala); and "Seasonal Adjustment," by Julius Shiskin.

The foregoing are but a small sample of the total, which constitutes a smorgasbord of high quality from which users of these volumes can choose according to their interests, needs, and mathematical competence.

For those interested in some of the perennial problems of theory, there are numerous attractions. The following group provides some examples: "Economies of Scale" (Vol. 4), by Joe S. Bain; "Welfare Economics" (Vol. 16), by E. J. Mishan (London School); "Economic Equilibrium" (Vol. 4), by Kenneth J. Arrow; and "Utility" (Vol. 16), by Nicholas Georgescu-Roegen.

The first two articles are brief and not overly technical. I found Mishan's conclusions especially interesting. He says that "it would be optimistic to expect that continued study of welfare economics will contribute toward making the world a happier place." Nevertheless, he believes that it "can do much to mitigate some of the more blatant ills of the affluent society by combating conservative presumption in favor of commercial criteria and by revealing manifest injustices in any price system that has not been corrected to make allowance for visible and widespread external diseconomies."

Arrow's presentation combines a history of the concept of equilibrium with an exposition of recent contributions, including his own and those of Wold, Hicks, Samuelson, and Debreu. The article by Georgescu-Roegen, who has been described by Samuelson as "a scholar's scholar and an economist's economist" [3], covers 30 pages plus an exhaustive bibliography. Virtually every important contribution from the Greeks to 1966 is included, accompanied by numerous equations, relations, and diagrams. It is truly impressive. For anyone who wishes to join in the seemingly endless struggle with the problem of value, this is unquestionably the place to start. It is particularly recommended to those who accept the "dogma of interpersonal noncomparability of utility," with respect to which the last section is especially pertinent. Though these last two articles are of primary interest to mathematical economists, those with only modest mathematical equipment (such as this reviewer) can learn a great deal from them.

A fair number of articles involve, in various degrees, the interaction of theory, measurement, and policy. Two examples, which bear on current controversies over the causes and cures of inflation, are "Inflation and Deflation" (Vol. 7), by Marvin Brofenbrenner, and "Quantity Theory" (Vol. 10: Money), by Milton Friedman.

Friedman outlines the history of the quantity theory, the Keynsian attack, and the subsequent reformulation. He also summarizes empirical evidence concerning the relation between changes in the quantity of money and changes in the price level. His policy conclusion is that "inflation can be prevented if and only if the stock of money per unit of output can be kept from increasing appreciably. Deflation can be prevented if and only if the stock of money per unit of output can be kept from decreasing appreciably." Altogether, this is the best presentation of Friedman's views that I have seen. Brofenbrenner discusses the problem of price level measurement; presents the major theories of price level movement with a number of effective diagrams; looks at some of the empirical evidence; and gives special attention to the redistributive effects of inflation on income and wealth.

The group of three articles on Index Numbers (Vol. 7) is also relevant. These are "Theoretical Aspects," by Eric Ruist (Stockholm School of Economics), "Practical Applications," by Ethel D. Hoover, and "Sampling," by Philip D. McCarthy.

A considerable proportion of the articles mentioned so far have a high mathematical content. However, this should not be allowed to obscure the fact that important areas of economics require descriptive-historical investigation and appraisal of ideologies, institutions, and policies. Examples are "Capitalism" (Vol. 2), by Calvin Hoover; "Welfare State" (Vol. 16), by Harry K. Girvetz; "Corporation" (Vol. 2), by Edward S. Mason; "Laissez-Faire" (Vol. 8), by H. Scott Gordon; and "Socialism" (Vol. 14), by Daniel Bell.

Hoover provides a clear and well-balanced account of the origins of modern capitalism, concluding that the traditional distinctions between capitalism and socialism have become blurred. Similarly, Girvetz traces the rise of the welfare state. He concludes that "there are no signs, outside of marginal groups centered in the United States, of a disposition to curb the welfare state. It rides the wave of the future." Mason shows that the modern corporation is not the simple creature of the legal textbooks, but a complex and evolving institution, whose functioning is not fully understood. Among other things, he points out that we lack "a clear and persuasive account of managerial motivation and behavior." Bell's excellent survey of socialism runs to 30 pages. Not only does it trace changes in the ideologies of the principal socialist thinkers from the beginning, but provides a country-by-country account of the socialist movement between the two world wars and in the present post-war period. Gordon's brief summary of laissez-faire is the best I know.

The biographies deserve more than passing notice, but here again comments must be brief. Generally speaking, they are intrinsically more interesting than technical articles, and I sympathize with the member of the Editorial Advisory Committee who recommended that the encyclopedia contain *only* biographies, on the grounds that these are all that anyone ever reads.

The decision to make the biographies longer than those in the 1930-35 volumes has been well justified. It enabled each writer to provide a more substantial account of the contributions of his subject and his place in the development of the various disciplines. This is well illustrated in the biographies of such greats as J. M. Keynes, by R. F. Harrod (Oxford); Alfred Marshall, by Bernard Corry (London School); Léon Walras, by William Jaffé; Vilfredo Pareto, by Maurice Allais (École Nationale Supérieure des Mines de Paris); Émile Durkheim, by Talcott Parsons; Max Weber, by Reinhard Bendix; and Sigmund Freud, by Robert R. Holt.

I was personally gratified to find biographies of Meyer Girshick (Vol.

6), by Kenneth Arrow, and A. P. Usher (Vol. 16), by J. H. Dales (Toronto). Girshick was not only a gifted statistician, as his peers have testified, but also a man beloved by all of his colleagues in the old Bureau of Agricultural Economics. Usher was one of my favorite professors—a stimulating teacher and a generous counselor.

Allowing for duplication, about 160 biographies are listed under economics, econometrics or economic history. These are all logical choices, though I am sure that most economists will readily think of others who might well have been included. On my list is Edwin F. Gay, described by Fritz Redlich in his biography of N. S. B. Gras (Vol. 6) as "America's first economic historian." It might also be noted that Gay, along with Jacob H. Hollander and Edwin G. Nourse, was one of the three editors for economics in the first *Encyclopedia of the Social Sciences.* One Fellow of the AAEA rates a biography: Thomas Nixon Carver (Vol. 2), by Overton H. Taylor, who mentions his "important pioneering work in the economics of agriculture." In my opinion, there are at least three or four other Fellows (living or dead) who would merit inclusion.

As to some general considerations, it may be recalled that the 1930-35 encyclopedia contained about 250 pages of introductory essays on the scope of the social sciences and the historical development of social thought and institutions. I believe that the usefulness of the present volumes would have been enhanced by similar essays summarizing progress from the Great Depression to the present, although the tight schedule under which this encyclopedia was completed might well have precluded such an addition. There are a number of articles, however, that touch on the more recent development of some of the disciplines. These include: under Anthropology, "The Field" (Vol. 1), by Joseph H. Greenberg; under Sociology, "The Development of Sociological Thought" (Vol. 15), by Shmuel N. Eisenstadt (The Hebrew University); "International Relations" (Vol. 8), by Chadwick P. Alger; "Political Science" (Vol. 12), by David Easton; and under Statistics, "The History of Statistical Methods" (Vol. 15), by M. G. Kendall (CEIR-London).

I think there have been at least four major developments in economics during the period in question. The first is the pervasive influence of John Maynard Keynes. The 1930-35 volumes refer to his *Treatise on Money,* but the *Theory of Employment, Interest and Money* was yet to come in 1936, bringing in its train the Keynsian Revolution and the New Economics. Articles in the present encyclopedia abound in references to such concepts as involuntary unemployment, the consumption function, liquidity preference, the investment function, and the multiplier—terms not found in the earlier volumes.

A second development has been the vast accumulation of economic data. Richard Ruggles in his article, "General," under Economic Data

(Vol. 4), identifies the main types as the national income accounts, flow-of-funds data, input-output data, and statistics on national wealth. Here again the hand of Lord Keynes is evident. As Ruggles states, he "fostered the concept of economic data as a systematic body of interrelated information." This list could well be supplemented by statistics in such areas as population, labor (including employment and unemployment), and food consumption.

Next comes the surge of mathematical economics and econometrics. To quote Samuelson, "In the middle third of the twentieth century, mathematics has everywhere swept through economics like an epidemic of measles sweeping through a new continent" [3]. In retrospect, Oskar Morgenstern's statement in the 1930-35 volumes appears modest indeed. He wrote (Vol. 5, p. 358): "In the future an increasing use of mathematics for purposes of both deduction and induction may be confidently expected." Of course, this use reflects not only the greater mathematical competence of economists, but also the proliferation of economic data just mentioned and the great advances in statistical methodology.

Lastly, there is a renewed concern with problems of economic policy. Economists (particularly those familiar with economic data and skilled in quantitative analysis) are being called on for help in such areas as housing, medical care, environmental pollution, economic development of poor countries, international monetary reform, and domestic wage and price policies. These activities extend to service on task forces of presidential candidates, as well as on or for the President's Council of Economic Advisers. In this connection, Herbert Stein, author of an article under Fiscal Policy, "Overview" (Vol. 5), and H. S. Houthakker, author of the biography of Ernst Engel (Vol. 5), have been named members of the new Council.

This trend seems all to the good, though some may disagree. It serves to maintain the vital link between research and critical economic problems; to test the workability of policies implied or expressed in existing studies; and to increase the relevance of future research. In short, it should help to counteract what Ben B. Seligman has termed the "thrust toward technique for its own sake" [4].

Though the great influence of Lord Keynes has been emphasized, Smith, Ricardo, Mill and Marshall are still important and, with the mathematization of economics, the stars of Walras, Pareto, and Irving Fisher are steadily rising. Even the almost forgotten Simon Newcomb has reappeared on the horizon.

I have no special qualifications for appraising the influence of pioneers in the other social sciences. However, it is evident that Freud still dominates the fields of psychology and psychiatry, although the influence of Jung is increasingly felt. Durkheim and Max Weber are still giants in sociological thought. Just who is who in anthropology is difficult for the nonspecialist to discern, but it is clear that the discipline still owes much to Boas and Malinowski. Pareto, of course, made important contributions to sociology as well as to economics, while the influence of Marx extends across the fields of economics, sociology, political science, and history.

This new encyclopedia contains such a wealth of valuable contributions that it may seem rather ungracious to enter any reservations. I must, however, register a few.

Among the topics that might well have received more attention, I will mention only environmental pollution and poverty. The first is touched on only briefly in articles relating to water resources and the problems of cities. The single article on poverty as such, "Poverty" (Vol. 12), is by the distinguished political and social historian, E. J. Hobsbawm (London). He deals with the history and measurement of poverty—the question of how to abolish it being outside the scope of his assignment. Both of these areas present urgent problems with which social scientists are already deeply involved, and there can hardly be any dearth of qualified contributors.

With respect to agriculture, one would naturally expect a lesser concern with its problems today than in 1930-35. This, of course, reflects the steady decline in the farm population of the industrialized countries and in the relative contribution of agriculture to the national income. On balance, however, my judgment is that the allotment of space to the problems of agriculture is about minimal and that the potential of AAEA economists to make significant contributions could have been more fully exploited. It is also a matter of some regret that no members of the Editorial Advisory Board are identifiable as agricultural economists. Though some readers of this Journal may be horrified at the suggestion, I think that an encyclopedia of agricultural economics and rural sociology, comparable in quality to the one under review, could be of very great value.

In the preparation of this review, I made some compilations of contributors with the object of obtaining some perspective on geographic distribution, academic affiliation, and other characteristics. It was not possible to do this in great detail or with complete accuracy, but I think there is enough evidence for a few broad generalizations. These refer to the whole range of contributions, not just those in economics.

The present encyclopedia is labeled "international," and this designation is justified. Over 320 contributors, approximately 20 percent of the total, are from outside of the United States. However, these are highly concentrated. About 130 are from the United Kingdom, over 50 from France, over 40 from Germany, and around 50 from other Western European countries. Altogether, these represent about 80 percent of the total number of foreign contributors. Those from the U.K. are dominated by Oxford, Cambridge, and the University of London (about half from this source are attributable to the School of Economics and Political Science); while in France, the University of Paris stands out. Other countries with a fair number of contributors are Israel, Australia-New Zealand, and Canada, although there are fewer from Canada than I would have expected. Contributions from South America, Asia, and Africa are disappointingly small.

From within the United States, contributors total close to 1,200, somewhat more than 1,000 from the colleges and universities. Of the latter, the East accounts for approximately 47 percent; the Midwest, 28 percent; the Far West, 18 percent; the South and Southwest combined, 7 percent.

Certain schools tend to carry a heavy weight. In the East, the combined contributions of Harvard, Yale, Princeton, Pennsylvania, Cornell, Johns Hopkins, MIT, Columbia, New York University, and City University of New York account for over two-thirds of the total. Columbia leads this group with over 70 contributors. In the Midwest, Chicago, Michigan, Illinois, Northwestern, Minnesota, Wisconsin, and Indiana account for nearly three-fourths of the total. Chicago tops the list, both regionally and nationally, with about 80 contributors. The California schools dominate the Far West. The University of California (including Berkeley, Los Angeles, and other locations) and Stanford together account for over 70 percent of the total, the Berkeley campus leading with about 60 contributors. In the South and Southwest, North Carolina, Duke, Vanderbilt, Virginia, and Texas account for over half of the total.

One great difficulty in reviewing an encyclopedia is that the further one reads, the greater is the urge to change the emphasis and organization, even to the point of rewriting it completely. Another is the everpresent temptation to go poking into areas well beyond one's own discipline. However, as economists are notoriously overspecialized, this is probably all to the good. For a few interesting side trips, I recommend "Judaism" (Vol. 9), by Jacob Katz (The Hebrew University); "Existential Psychology" (Vol. 13), by Rollo May; "Minorities" (Vol. 10), by Arnold M. Rose; and "Civil Disobedience" (Vol. 2), by Christian Bay (University of Alberta). For a good scare, read "Nuclear War" (Vol. 11), by Herman Kahn, the controversial expert in this field. Fortunately, deadlines force one to stop some place and this is it.

Though I have entered a few caveats, these are minor in relation to the great merits of this encyclopedia as a whole. In my opinion, it is clearly superior to that published in the thirties. Although the earlier version was the work of a talented and formidable array of scholars, it leaned in the direction of short and relatively nontechnical articles designed to have a rather wide popular appeal. However admirable the objective, this approach tends to suffer from the fact that such articles often lack enough substance to attract the specialist, while at the same time they are likely to be too technical or colorless to held the interest of the general reader.

This encyclopedia is by social scientists and for them. The generally high quality of the articles and the stature of the authors should ensure wide use by both established professionals and graduate students. Of course, as with all encyclopedias, there is bound to be some lag between much that is written and the emergence of new ideas and the march of events. With respect to economic theory, the 1930-35 encyclopedia came out a little too soon to incorporate the ideas of such people as Chamberlin, Joan Robinson, Hicks, Harrod, Myrdal, and the later work of Keynes. The contributions of these and others have recently been placed in perspective by Shackle in his *Years of High Theory* [6]. On balance, the present encyclopedia is more contemporary with respect to ideas, methodology, and recent events than was its predecessor. Taken as a whole, the *International Encyclopedia of the Social Sciences* is an intellectual achievement of the first magnitude and deserves to be called a "Mightie Werke."

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Some Implications of the EEC's Agricultural Price Policy*

DONALD J. EPP

This article indicates elements of the Common Agricultural Policy of the European Economic Community that may result in substantial changes in the future. Regional price indexes are developed for several grain and livestock commodities and projected to 1970 and 1975. By combining these projections with the results of an EEC survey of family farm incomes, this article shows that the projected price changes will favor the farmers with the highest incomes. Also, the operation of the Agricultural Fund causes a transfer of foreign exchange from member countries with agricultural net import balances to member countries with agricultural net export balances. Raising the internal prices of imported and exported commodities in order to establish a common price for the EEC has further increased the foreign exchange transfers.

INTERNATIONAL economic headlines have shifted from the arduous deliberations of the Kennedy Round of tariff negotiations and its accompanying drama of creating an agricultural policy for the EEC to the problems facing the United States and its balance of payments. This change of events might lead one to assume that the EEC has established a firm policy with respect to agricultural prices. It is the purpose of this paper to investigate the validity of such an assumption by raising the question: Have the initial steps in establishing an EEC policy activated forces that will ultimately lead to substantial revisions in EEC policy? If the answer is affirmative, it is prudent that we understand the working of these forces so as to anticipate the nature of future changes.

The hypothesis in this paper is that present EEC agricultural price policies will result in further disparities of income between large and small farms, and since the proportion of large and small farms is not uniform throughout the Community, this will hurt the foreign exchange position of some member countries and lead to economic and social problems within these countries.

A Study of Regional Prices

This study of the Common Agricultural Policy of the EEC emphasized three points: the impact of policy on prices received by producers, con-

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sideration of regions that are reasonably homogeneous types of farming areas, and projection of the impact on prices to 1970 and 1975. Since the influence of any particular commodity price is likely to be affected by differences in enterprise combinations, the three large countries of the EEC were divided into regions that reflect general differences in commodities produced or types of farm organization. The eighteen agricultural regions of the EEC used in this study are shown in Figure 1. Projecting prices to 1970 and 1975 was not intended to prophesy, but rather, by extending the results of current policy forces under realistic assumptions about market conditions, to amplify any inconsistencies or potential conflicts.

The data come mainly from published reports of producer prices. Occasionally, needed information was obtained from unpublished sources, or was calculated from market prices with the use of marketing margins supplied by government and university researchers. For commodities that include several quality grades with different prices, such as beef and veal, the amount of each grade marketed was used as a weight for determining the weighted average price. In such cases, the resulting price estimates better reflect the returns to the farmer than do the unadjusted prices.[1]

The study of prices proceeded in three steps. First, the prices for a three year period centered on 1960 were analyzed to obtain the relationships between regions prior to the introduction of the EEC policies. Second, regional prices were projected to 1970, utilizing the price policies and price levels determined by the EEC for the unified market. And third, the price projections were extended to 1975 under the alternative assumptions (1) that nominal prices will remain at 1963–65 levels or (2) that policy-determined prices will increase at about the average rate of increase in nonagricultural prices.

In the second and third stages, the specific projection procedures varied for different groups of commodities, depending on the policy provisions affecting them. For grains, the 1970 intervention price of the Common Agricultural Policy provided the base from which producer prices were projected by maintaining the relationship between support prices and producer prices that existed in the base period. The Italian price projections were modified because of the special policies that apply to that country. All grain prices were further adjusted to reflect the transportation costs for moving grain between regions, thus providing an internally consistent price surface.

Because the production processes for hogs, broilers, and eggs are dependent on feed grains, the producer prices for these products were calculated from the grain prices estimated for each region and from producmore to the Fund than they receive, while the French, and possibly the Dutch, will receive more from the Fund for export restitutions than they contribute in import duties.

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[1] See Epp [1, esp. Ch. 4 and the Appendixes] for a detailed description of the data and the price projection procedures.

While importing has always involved the loss of foreign exchange to purchase the commodities, any duty levied on the imports stayed within the country, being collected by the government. In essence, import duties transfer wealth from the purchasers of imported goods to the recipients of government expenditures. The basic principle does not change under the EEC policies, but because the taxing agent is the Agricultural Fund rather than the national government, the duty becomes an additional foreign exchange loss. This transfer of wealth still goes from the purchaser of imports to the recipient of Agricultural Fund expenditures, but the potential problem is that most of the recipients live in a different country than the majority of the contributors. Consumers in countries requiring large imports of agricultural products will contribute more to the Fund, while the producers of surplus commodities requiring support purchases and export restitutions will receive more from the Fund.

The analysis so far considers only the change of paying the duties to the Agricultural Fund rather than to national governments. But the prices currently established by the EEC regulations increase the transfer of funds from importing countries to surplus producing countries. Grain policies are an example. Since Italy is a large importer of feed grains, the increase in Italian feed grain prices results in higher duties and greater payments to the Agricultural Fund than would have been the case under Italy's former tariff rates. At the same time, prices will increase in France, resulting in the need for larger export subsidies to permit the surplus grain to compete on world markets. This means that the French exporters and farmers receive more from the Agricultural Fund than would have been the case under the former French tariffs.

An estimate of the income transfers from grain trade operations of the Agricultural Fund is shown in Table 2. Germany, Italy, Netherlands, and Belgium-Luxembourg are net contributors to the Fund while France is a net recipient. The purchasers of grains imported into the five net contributor countries (and, ultimately, the consumers of products made from the imported grains) paid almost 99 percent of the import levies received by the Fund. On the other hand, producers in France, the net recipient country, received almost 63 percent of the export restitutions paid from the Fund.

Table 2 also shows the magnitude of the import levies and export restitutions relative to the value of grain traded. The total import levies paid were 56 percent of the value of the imports and the export restitutions were almost 42 percent of the value of the exports. Thus, the Fund transactions concerning grain exports and imports are not only large in total

Table 2. Estimated values of grain imports and exports with import levies and export restitutions for the countries of the European Economic Community, 1967/68

Countries	Value of imports[a]	Import levies (paid to the Fund)	Value of exports[a]	Export restitution (received from the Fund)	Net position with the Fund (+net contributor) (−net recipient)
			dollars		
Germany	393,807,210	227,971,320	50,523,070	23,406,360	+204,564,960
Italy	435,868,060	239,324,420	54,136,800	25,263,840	+214,060,580
Netherlands	232,176,230	128,466,340	22,511,280	10,977,960	+117,488,380
Belgium-Luxembourg	119,296,040	68,136,570	12,938,540	6,041,670	+ 62,094,900
France	12,548,700	8,295,130	283,296,160	110,561,900	−102,266,770

[a] The value of exports and imports is calculated from reported volume of trade and the annual average price for each grain at Rotterdam. The volume of grain traded and the average prices used are found in European Economic Community [3].

value but are a large portion of the total receipts and costs of exporting and importing grains.

While this example is the most obvious, similar conclusions can be drawn from Germany's imports of livestock products and Dutch exports of dairy products. In essence, the financing of the Agricultural Fund causes a transfer of funds from net importing countries to net exporting countries, and establishing a common price level increases the magnitude of this transfer.

Implications

The most important implication of the preceding analysis for American policy is that the EEC policies are likely to shift and adjust to the pressures indicated. To assume that the results of the long and arduous negotiations will provide a rigid price and income policy for European agriculture is a mistake. While the basic direction of the EEC policies is unlikely to change, it is probable that the specific policy measures or price levels for certain commodities may be changed. Naturally, any change in the composition of the Community will necessitate adjustments and such an occasion may be used to correct some of the imbalances currently developing. If new members are admitted to the EEC, recognition of the difficulties in the present system may facilitate a clearer understanding of any policy changes that occur.

In order to assess the likelihood of alternative policies being adopted, we need to know more about the relative political strength of different groups in the new policy making organizations in Western Europe. The differences in the incidence of benefits and costs of the Common Agricultural Policy are apparent, but it is difficult to determine the impact of income disparities and transfer of income on future policy decisions. An analysis of the role of the various economic and political groups in form-

Projecting the Size Distribution of Agricultural Firms—An Application of a Markov Process with Non-Stationary Transition Probabilities*

M. C. HALLBERG

The first-order Markov chain model is frequently used to project the future size distribution of firms in a particular industry. This model, however, is based on the rather restrictive assumption that the transition probabilities remain constant over time. This assumption was found to be inappropriate in the case of plants manufacturing frozen milk products in Pennsylvania during the period 1944-1963 and, if adopted, could lead to erroneous results as some actual predictions indicated. This article suggests a method, based on multiple regression techniques, of replacing the constant transition probabilities with probabilities which are a function of various factors including structural characteristics in the industry. The results of this procedure compared quite favorably with those of the assumption of constant probabilities.

THE dynamic and stochastic nature of most economic phenomena has led several economists to postulate that the evolution of certain economic variables over time can be characterized as a stochastic process. The Markov chain model is frequently utilized as the stochastic model with which to predict the future time path of such variables. As a method of analyzing the *current* movement of a variable in order to predict its future movement, the Markov chain model can be extremely useful to social scientists in designing policy measures compatible with the *future* movement of the stochastic variable in question. Further, once the process of change is understood, one may then be in a position to suggest how the process must be altered in order to realize some specific target outcome.

One of the most demanding assumptions of the Markov chain model is that the probability of occurrence of a particular outcome in any one trial of the sequence does not change throughout the entire sequence—that is, the transition probabilities are assumed to be stationary. This means that once the process of change has been established, the same process of change will continue indefinitely.

Providing "all else remains equal," this may be a very realistic assumption. But when such phenomena as the size distribution of firms in an industry are studied, the stationarity assumption appears to be untenable in most cases. Changes in numerous exogenous variables—wage rates, factors

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affecting demand for the industry's product, technology, and legal requirements—are likely to result in non-stationary transition probabilities. Simply to argue, as is commonly done, that the results of the Markov chain model are what can be expected (in a probabilistic sense), assuming all exogenous variables remain the same, is neither helpful nor informative.

The purpose of this paper is twofold. First, a procedure is outlined that is designed to incorporate a non-stationarity assumption into the Markov chain model. This is done by replacing the stationary probabilities with probabilities that are a function of exogenous factors subject to change throughout the sequence of experiments. Second, the effect of this procedure is illustrated with the use of data on changes in the size distribution of plants manufacturing frozen milk products in Pennsylvania.

The Basic Model and Tests

A stochastic process may be described as a sequence of experiments in which the outcome on each individual experiment in the sequence depends on some probability, p, or chance event. If the probability of the outcome of a given trial, say the t^{th}, depends only on the outcome of the immediately preceding trial, if this probability is the same for each trial in the sequence, and if the set of possible outcomes is finite, the process is known as a first-order Markov chain. For systems thus characterized, one may deduce the probability, p, that the system will be in a given state at a given time, t, from a knowledge of its state at an earlier time, t-1 [see 5, 8].

Consistent with our definition of a Markov chain, let:

s_i = the i^{th} state of a set of n states, $i = 1, 2, \cdots, n$,

$P = [p_{ijt}]$ = the $n \times n$ matrix of transition probabilities, where p_{ijt} represents the probability that outcome s_j will result from the t^{th} experiment given that outcome s_i occurred on the $(t-1)^{th}$ experiment, $t = 1, 2, \cdots, T$,

$X_0 = [x_{0i}]$ = the initial starting state vector or the initial configuration of individuals in the n states, where x_{0i} represents the number of individuals in state s_i during time period $t = 0$,

$X_t = [x_{ti}]$ = t^{th} configuration vector, and

m_{ijt} = number of individuals in s_i during period $t-1$ who moved to s_j in period t.

In addition, we impose two constraints on the elements of the matrix P:

$$p_{ijt} \geq 0 \quad \text{for all } i, j, t, \text{ and} \tag{1}$$

$$\sum_{j=1}^{n} p_{ijt} = 1 \quad \text{for all } i \text{ and } t. \tag{2}$$

Given P and X_0, the future path of the stochastic process is given by:

$$X_t = X_0 P^t. \tag{3}$$

If P is a stochastic matrix satisfying (1) and (2), there exists an $n\times n$ matrix P_e to which P^t will converge as $t\rightarrow\infty$ consisting of n rows which are exactly alike [5]. Hence, X_0P_e gives the equilibrium configuration, X_n, of the stochastic process.

Anderson and Goodman [1] have shown that the maximum likelihood estimates of the transition probabilities based on actual movements of individuals between states are:

$$\hat{p}_{ijt} = m_{ijt} \Big/ \sum_{j=1}^{n} m_{ijt}. \tag{4}$$

If information is available for several time periods—i.e., if m_{ijt} are available for each of the $t=1, 2, \cdots, T$ time periods—Anderson and Goodman [1] have also shown that the maximum likelihood estimates of the stationary transition probabilities are:

$$\hat{p}_{ij} = \sum_{t=1}^{T} m_{ijt} \Big/ \sum_{j=1}^{n}\sum_{t=1}^{T} m_{ijt}. \tag{5}$$

Given the estimates, $\hat{p}_{ij}$, it is possible to test the null hypothesis that the true transition probabilities are stationary. The test statistic is [1]:

$$-2\log\lambda = 2\left(\sum_{i}^{n}\sum_{j}^{n}\sum_{t=1}^{T} m_{ijt}\log\hat{p}_{ijt} - \sum_{i}^{n}\sum_{j}^{n}\sum_{t=1}^{T} m_{ijt}\log\hat{p}_{ij}\right) \tag{6}$$

and is distributed as χ_ν^2, with $\nu=(T-1)\cdot(n-1)\cdot n$ degrees of freedom.[1]

Derivation of Non-Stationary Transition Probabilities

When the test for stationarity indicates that the null hypothesis cannot be accepted, the model must be modified to incorporate the alternative hypothesis. The alternative hypothesis with which we must contend is: the transition probabilities are not constant over time. *A priori* information may reveal some indication as to the nature of the functional relation between the transition probabilities and certain exogenous factors. For example, the transition probabilities may fluctuate cyclically. They may change with fluctuations in profit rates, inventory accumulations, demand, advertising, interest rates, etc. Or, in the case of a sociological analysis, they may change with fluctuations in various non-economic factors.

Telser [11, 12, 13] has utilized the hypothesis of non-stationarity in two analyses dealing with the demand for branded goods. In Telser's work, however, the transition probabilities, as well as the effect of the exogenous variables on the transition probabilities, were estimated indirectly because a time series of actual transition probabilities was unavailable.

In our case, we assume the existence of a time series of transition probability matrices and desire a statistical relationship between the p_{ijt}'s and a set of exogenous factors z_{kt}, $k=1, 2, \cdots, K$. We propose fitting a least squares regression equation of the form,

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[1] For large values of ν, $\{T_\alpha+\sqrt{2\nu-1}\}/2$ gives the approximate value of the tabulated χ^2 where T_α is the α point of the culmative normal distribution [see 7 p. 428].

$$\hat{p}_{ijt} = \hat{\alpha}_{ij} + \sum_{k=1}^{K} \hat{\beta}_{ijk} z_k,$$

for each of the n^2 cells of the transition probability matrix. For resaons that will become obvious later, we will include all data pertaining to any one row of the P matrix into a single regression equation so as to estimate the $n+nK$ parameters for that one row simultaneously.

Accordingly, we assume the sample observations are generated by the linear regression model:

(7) $P=QB+U$ for each i (i.e., row of the transition matrix)

with $E(U)=\phi$ and $E(UU')=\sigma^2 I$ where the $Tn\times 1$ vector of observations on the dependent variable is

$$P = \left|\begin{array}{c} P_1 \\ \cdot \\ \cdot \\ \cdot \\ P_j \\ \cdot \\ \cdot \\ \cdot \\ P_n \end{array}\right| \qquad \underset{T\times 1}{P_j} = \left|\begin{array}{c} p_{ij1} \\ \cdot \\ \cdot \\ \cdot \\ p_{ijt} \\ \cdot \\ \cdot \\ \cdot \\ p_{ijT} \end{array}\right|;$$

the $(Tn)\times(n+K)$ matrix of observations on the $n+nK$ independent variables is

$$Q = \begin{bmatrix} Q_0 & & & \phi \\ & Q_0 & & \\ & & \ddots & \\ \phi & & & Q_0 \end{bmatrix}, \qquad \underset{T\times(1+K)}{Q_0} = [Z_0 Z_1 \cdots Z_k \cdots Z_K]$$

where Z_0 is a $T\times 1$ vector with all elements unity and Z_k is a $T\times 1$ vector of observations on the k^{th} exogenous variable; the $(n+nK)\times 1$ vector of coefficients is

$$B = \begin{bmatrix} B_1 \\ \cdot \\ \cdot \\ \cdot \\ B_j \\ \cdot \\ \cdot \\ \cdot \\ B_n \end{bmatrix} \qquad B_j = \begin{bmatrix} \alpha_{ij} \\ \beta_{ij1} \\ \cdot \\ \cdot \\ \cdot \\ \beta_{ijk} \\ \cdot \\ \cdot \\ \cdot \\ \beta_{ijK} \end{bmatrix} = \begin{bmatrix} \alpha_{ij} \\ \hline B_{ij} \end{bmatrix}$$

where α_{ij} is the intercept and β_{ijk} the slope coefficient on the k^{th} independent variable; and U is a $Tn \times 1$ vector of random errors.

This formulation is based on the assumption that the same set of exogenous factors can be used to explain the variation in each p_{ij} in any row, i, of the transition probability matrix.[2] This seems a reasonable assumption since we are attempting to explain why elements in the i^{th} state move to another state or stay in the same state. The behavior of elements in other states may be governed by a different set of exogenous factors.

The least squares estimate of B is

$$\hat{B} = (Q'Q)^{-1}Q'P. \tag{8}$$

But from the construction of Q we note that

$$\hat{B}_j = (Q_0'Q_0')^{-1}Q_0'P_j \quad \text{for all } j, \tag{9}$$

which contains the estimated intercept and slope coefficients for the j^{th} element in the i^{th} row of the transition probability matrix.

Substituting the least squares estimate of B_j into the equation used to predict p_{ijt}, we have:

$$\hat{p}_{ijt} = Q^*\hat{B}_j. \tag{10}$$

This can be written equivalently in deviation form as:

$$\begin{aligned} \hat{p}_{ijt} &= \hat{\alpha}_{ij} + Z^*\hat{B}_{ij} = (\bar{p}_{ij.} - \bar{Z}\hat{B}_{ij}) + Z^*\hat{B}_{ij} \\ &= \bar{p}_{ij.} + (Z^* - \bar{Z})(z'z)^{-1}z'p_j, \end{aligned} \tag{10'}$$

where the starred vectors contain the observed values of the Z_k in time period t, $\bar{Z}$ is a vector of means of the Z_k over T time periods, z is a $T \times K$ matrix of the Z_k in deviation form, and p_j is a $T \times 1$ vector of transition probabilities in deviation form.

Since $p_{i.t} = 1$ for each i and t,

$$\sum_{j=1}^{n} \bar{p}_{ij.} = 1 \quad \text{for each } i.^3 \tag{11}$$

But $p_{i.t} = 1$ and equation (11) together imply that

$$\sum_{j=1}^{n} \hat{B}_{ij} = \sum_{j=1}^{n} (z'z)^{-1}z'p_j = (z'z)^{-1}z' \sum_{j=1}^{n} p_j = \phi, \tag{12}$$

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[2] This formulation also depends on the rather tenuous assumption that the variances of the error terms of all cells in a given row are equal. A more realistic assumption might be that $\sigma_{ij} = f(i-j)$. If this form of heteroskedasticity is assumed, it can be demonstrated that the results obtained in equations (11) to (13) in this section remain unchanged. Only the variances of our least squares estimates will be affected.

[3] The dot notation is used here and elsewhere in this paper to indicate summation over the entire range of the subscript replaced by a dot. As usual a bar placed over the variable indicates a mean value.

where ϕ is the $K\times 1$ null vector. Therefore,

$$\sum_{j=1}^{n} \hat{p}_{ijt} = \sum_{j=1}^{n} \bar{p}_{ij.} = \sum_{j=1}^{n} \hat{\alpha}_{ij} = 1 \tag{13}$$

This result is important. It means that the constraint on the transition probabilities given by equation (2) is satisfied. Further, the information obtained from equations (12) and (13) may be useful in an application of restricted least squares.

The $K+1$ restrictions from equations (12) and (13) are equivalent to imposing the restriction

$$\begin{bmatrix} 1 \\ \phi \end{bmatrix} = RB \tag{14}$$

on model (7) where R is the $(K+1)\times(n+nK)$ matrix consisting of n identity matrices of order $(K+1)$.

Providing all parameters of the n equations in a given row are to be estimated, the $K+1$ independent restrictions imposed by (14) are satisfied, and we can estimate the coefficient vector, B, of (7) by classical least squares.

If some of the parameters of these n equations are assumed *a priori* to be zero, it appears desirable to apply the restricted least squares technique as outlined in Goldberger [2]. Specifically, on the basis of equations (11) to (13), it would seem reasonable to impose restrictions of the type specified in equation (14). That is, the estimated non-zero intercepts should sum to unity and the estimated non-zero slope coefficients on a given exogenous variable should sum to zero in any one row of the transition probability matrix.

Once all parameters have been estimated, the individual transition probabilities in time period t can be estimated, given values of the exogenous variables in the same time period.

One problem yet remaining is that the estimated transition probabilities, while always satisfying equation (2), will not necessarily lie within the range specified by equation (1). To avoid this difficulty, the following rule is suggested: First, if in any time period, t, $\hat{p}_{ijt}$ becomes negative (greater than unity), set $\hat{p}_{ijt}$ equal to zero (unity). Secondly, divide all remaining positive $\hat{p}_{ijt}$ in row i in time period t by their sum (set all other $\hat{p}_{ijt}$ equal to zero). This rule is admittedly arbitrary but is believed reasonable and, in the absence of a satisfactory alternative, was used in the analysis which follows.

The newly defined transition probabilities are to be substituted for the constant probabilities in the Markov chain model. Now, however, a study of the properties of the process over time must involve the use of simulation techniques, since there is no general solution to the difference equation

$$X_t = X_{t-1}\hat{P} \tag{15}$$

(where $\hat{P}$ is the $n \times n$ matrix with elements in the form of equation (10) above) comparable to that of equation (3) unless, of course, we have at our disposal "equilibrium" values for the exogenous variables.

Implications of Non-Stationary Transition Probabilities

Sales volume data over a 20-year period, from 1944 to 1963, for Pennsylvania plants manufacturing frozen milk products were obtained from the Crop Reporting Service, Pennsylvania Department of Agriculture.[4] During this period, the movement of 884 plants (all of which were in operation for at least one year during the 20-year period, but not all 884 during the same year) from one size category (state) to another was observed. For our purposes, five size categories were established:

s_1 · · · plants producing 50,000 gallons of output or less annually,
s_2 · · · plants producing between 50,001 and 300,000 gallons of output annually,
s_3 · · · plants producing between 300,001 and 1,000,000 gallons of output annually,
s_4 · · · plants producing more than 1,000,000 gallons of output annually, and
s_5 · · · plants producing no output during the given year.

The fifth state was utilized to represent a pool from which entrants may come and to which exants may go. Thus, the entire 884 firms will be accounted for in each of the time periods under consideration even though some may go out of business. Transition probabilities were estimated for each of the 19 time periods according to equation (4) and $\hat{p}_{ij}$ were estimated according to equation (5). The matrix $[\hat{p}_{ij}]$ is:

$$\hat{P} = \begin{bmatrix} .76816 & .04764 & .00119 & .00040 & .18261 \\ .07612 & .86597 & .02212 & .00066 & .03513 \\ .01786 & .06786 & .83928 & .04643 & .02857 \\ .00369 & .00369 & .01845 & .96310 & .01107 \\ .03356 & .00484 & .00041 & .00041 & .96078 \end{bmatrix} \tag{16}$$

The computed X^2 for testing the hypothesis that the transition probabilities are constant is 749.14 with 360 degrees of freedom. Hence, we fail to accept the hypothesis that the transition probabilities are constant over the 20-year period.

It is instructive at this point to examine the results of using inappropriate transition probabilities. First, I used the $\hat{p}_{ij}$ given in (16) and the configuration of plants observed in 1944 as X_0. Second, I used the $\hat{p}_{ij}$ observed for the period 1954–1955 and the configuration of plants observed in 1955 as X_0. Third, I used the $\hat{p}_{ij}$ observed for 1949–50 and the configuration of plants observed in 1950 as X_0. Finally, I used the maximum likelihood estimates, $\hat{p}_{ij}$, over the period 1949–54 and the configuration of plants observed in 1949 as X_0.[5] In each case, I employed the Markov chain model with the stationarity assumption to simulate the future configuration of plants over the relevant time periods ending with 1963. The results are depicted in Figure 1. The equilibrium configuration for the four cases are respectively:

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[4] For further discussion and analysis of these data see [6].

$$\begin{aligned} &1944\text{–}1963 - X_e = [120 \quad 75 \quad 16 \quad 30 \quad 643] \\ &1950 \qquad\quad\; - X_e = [236 \quad 124 \quad 47 \quad 0 \quad 477] \\ &1955 \qquad\quad\; - X_e = [117 \quad 57 \quad 10 \quad 0 \quad 700] \\ &1949\text{–}1954 - X_e = [155 \quad 102 \quad 36 \quad 45 \quad 546] \end{aligned}$$

None of these four cases yields reasonably good estimates of the 1963 structure, as can be seen in Figure 1.

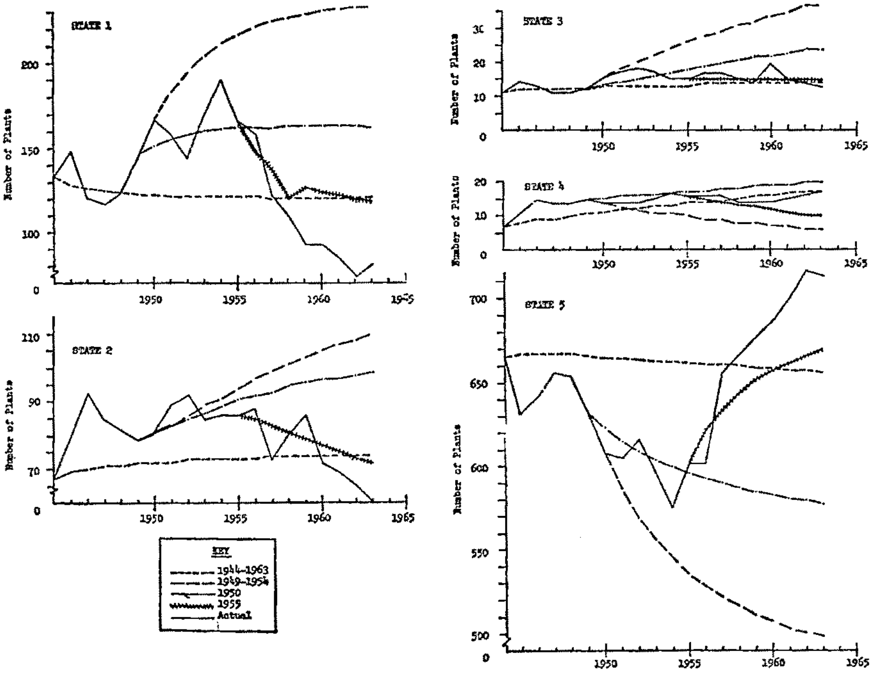

Figure 1. **Markov chain predictions with stationary transition probabilities**

The fourth case considered deserves special comment. Assume for the moment that the present year is 1954 and we have only the data for 1949 to 1954. Upon calculating the transition probabilities and applying the χ^2

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[5] In this latter case, I accepted the null hypothesis that the transition probabilities were stationary according to the likelihood ratio criterion given in equation (6).

test, we find them to be stationary, and we proceed to make judgments on the basis of Markov chain predictions using this information. By 1957 we would be extremely embarrassed. The embarrassment would be due, of course, to the fact that changes in income, consumption, and costs after 1955 had a substantial impact on market structure in the industry, even though the χ^2 test suggested that our transition probabilities were stationary. Had we known the effect of rising incomes, demand, costs, etc., on market structure in the frozen milk products industry, we might have been able to predict the 1957 and subsequent years' structure more precisely.

In an attempt to improve upon the predictive and explanatory power of the Markov chain model, the technique outlined in the preceding section was applied to these data. In this analysis, the following exogenous variables were utilized on the hypothesis that factors influencing the demand for and costs of producing manufactured dairy products would explain a major portion of the variation in the observed transition probabilities:

z_{1t} = Index of hourly earnings of workers engaged in food manufacturing industries in the U. S., deflated [15],
z_{2t} = Population in Pennsylvania, [10, 16],
z_{3t} = Per capita income in Pennsylvania, deflated [10, 16],
z_{4t} = Price per hundredweight received by Pennsylvania farmers for all milk, deflated [14], and
z_{5t} = Index of retail price of all dairy products in the U. S., deflated [14].

We have previously specified that the transition probabilities should fall within the closed interval from zero to unity, and hence, we would like to impose the restriction that $0 \leq \hat{p}_{ijt} \leq 1$ for all feasible values of the exogenous variables. This condition would have been met had we taken a reciprocal transformation of all exogenous variables and restricted all the α's to the closed interval from zero to unity.[6] Since it is not possible to impose such a restriction when using least squares, and since initial graphical work suggested that a logarithmic transformation might well be superior to a reciprocal transformation, all exogenous variables were expressed in logarithms prior to an application of model (7) to these data.

Prior regression analysis indicated that lagged values of the exogenous variables did not produce significant results and that some of the regression coefficients were not significantly different from zero at the ten percent level. If the latter were true for a given equation, that equation was reestimated under the following restrictions:

(1) the omitted coefficients were zero,

(2) $\sum_{j=1}^{5} \hat{\alpha}_{ij} = 1$ for all $i = 1, 2, \cdots, 5$ (including the zero coefficients),

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[6] This could be done using quadratic programming; however, information pertaining to the reliability of estimates would be unavailable.

and

(3) $\sum_{j=1}^{5} \beta_{ijk} = 0$ for all i and all k (again including the zero coefficients).

Statistics from the resulting regression analysis are as follows:

Row 1:

$\hat{\alpha}_{11} = -7.0361$ (1.2228)

$\hat{\alpha}_{12} = 2.8341$ (1.2019)

$\hat{\alpha}_{15} = 5.2020$ (1.2228)

$\hat{\beta}_{112} = -1.9414$ (0.3039)

$\hat{\beta}_{152} = 1.9414$ (0.3039)

$\hat{\beta}_{124} = 0.5666$ (0.2539)

$\hat{\beta}_{154} = -0.5666$ (0.2539)

$\hat{\beta}_{125} = -1.5887$ (0.6677)

$\hat{\beta}_{155} = 1.5887$ (0.6677)

$R^2 = 0.9935$

Row 2:

$\hat{\alpha}_{21} = -0.3224$ (0.5655)

$\hat{\alpha}_{23} = 1.1350$ (0.4257)

$\hat{\alpha}_{25} = 0.1874$ (0.5655)

$\hat{\beta}_{222} = 0.2765$ (0.1058)

$\hat{\beta}_{232} = -0.2765$ (0.1058)

$\hat{\beta}_{215} = 0.1976$ (0.2811)

$\hat{\beta}_{225} = -0.1216$ (0.2117)

$\hat{\beta}_{255} = -0.0760$ (0.2812)

$R^2 = 0.9979$

Row 3:

$\hat{\alpha}_{33} = -9.7418$ (1.2492)

$\hat{\alpha}_{34} = 10.7418$ (1.2492)

$\hat{\beta}_{331} = -1.6842$ (0.2889)

$\hat{\beta}_{341} = 1.6842$ (0.2889)

$\hat{\beta}_{332} = 3.5671$ (0.4324)

$\hat{\beta}_{342} = -3.5671$ (0.4324)

$\hat{\beta}_{323} = 0.0240$ (0.0020)

$\hat{\beta}_{333} = -0.0240$ (0.0020)

$R^2 = 0.8882$

Row 4:

$\hat{\alpha}_{41} = -0.0321$ (0.0700)

$\hat{\alpha}_{43} = -0.1794$ (0.0700)

$\hat{\alpha}_{44} = 1.3006$ (0.0700)

$\hat{\alpha}_{45} = -0.0891$ (0.0700)

$\hat{\beta}_{414} = 0.2443$ (0.0970)

$\hat{\beta}_{434} = 0.2751$ (0.0970)

$\hat{\beta}_{444} = -0.4670$ (0.0970)

$\hat{\beta}_{454} = -0.0524$ (0.0970)

$R^2 = 0.9986$

Row 5:

$\hat{\alpha}_{51} = 3.6149$ (0.2082)

$\hat{\alpha}_{52} = 0.2208$ (0.0324)

$\hat{\beta}_{552} = 0.7602$ (0.0705)

$\hat{\beta}_{513} = -0.4078$ (0.0223)

$$\begin{array}{llll}
\hat{\alpha}_{55} = & -\,2.8357\ (0.2082) & \hat{\beta}_{553} = & 0.4078\ (0.0223) \\
\hat{\beta}_{511} = & -\,0.4625\ (0.0271) & \hat{\beta}_{514} = & 0.8000\ (0.0596) \\
\hat{\beta}_{521} = & -\,0.0988\ (0.0149) & \hat{\beta}_{554} = & -\,0.8000\ (0.0596) \\
\hat{\beta}_{551} = & 0.5613\ (0.0271) & \hat{\beta}_{515} = & 1.1982\ (0.1037) \\
\hat{\beta}_{512} = & -\,0.7602\ (0.0705) & \hat{\beta}_{555} = & -\,1.1982\ (0.1037) \\
 & & R^2 = & 0.9902.
\end{array}$$

Since all exogenous variables were expressed in natural logarithms, the rate of increase (or rate of decrease if the relevant regression coefficient is negative) of the dependent variable declines as a given exogenous variable increases. That is, at a given level of z_k:

$$\frac{\partial p_{ij}}{\partial z_k} = \lambda \hat{\beta}_{ijk} z_k^{-1}$$

where $\lambda = \log_{10} e = .4343$.

Several interesting features are suggested by the regression estimates. First is the effect of changes in price received by farmers (and hence the cost of milk to processors) on the movement of firms from one state to another. As this variable increases, the probability of small firms becoming larger increases slightly ($\hat{\beta}_{124} > 0$). The indication is that when the farm price of milk increases, management of some of the already established firms in the frozen milk products industry in Pennsylvania see a need to expand the size of their business. Management of the large firms, on the other hand, apparently becomes more reluctant to expand their operations as the farm price of milk increases ($\hat{\beta}_{414}$, $\hat{\beta}_{434} > 0$ while $\beta_{444} < 0$).

When we concentrate on those factors associated with a shift in demand, we see that the probability of new firms entering the industry declines as per capita income increases ($\hat{\beta}_{513} < 0$) and as population increases ($\hat{\beta}_{512} < 0$). Furthermore, an increase in population appears to be associated with a decrease in the probability of established firms becoming larger ($\hat{\beta}_{232}$, $\hat{\beta}_{342} < 0$).

Much more work needs to be done in order to determine the appropriate combination of explanatory variables in the analysis illustrated here. We have included both profit and cost considerations but not technological considerations. We confined our analysis to the short-run, ignoring such long-run considerations as historical profit levels. Finally, due to data limitations, some of the variables used were not entirely satisfactory for explaining variations in the behavior of Pennsylvania firms.

Despite these limitations, the estimated relations presented above were used to simulate the number and size distribution of plants between 1945 and 1963. This was done in a recursive fashion according to equation (15), where the output generated for one period was used as input for the next.

To start the procedure, the initial configuration of plants existing in 1944 was used.

The results of this simulation run are plotted in Figure 2. Considering the entire time series, the configurations simulated under the assumption of non-stationary transition probabilities appear much more realistic than those simulated under the assumption of stationary probabilities. As may be expected, the model in general generated its poorest information for the war and immediate post-war years.

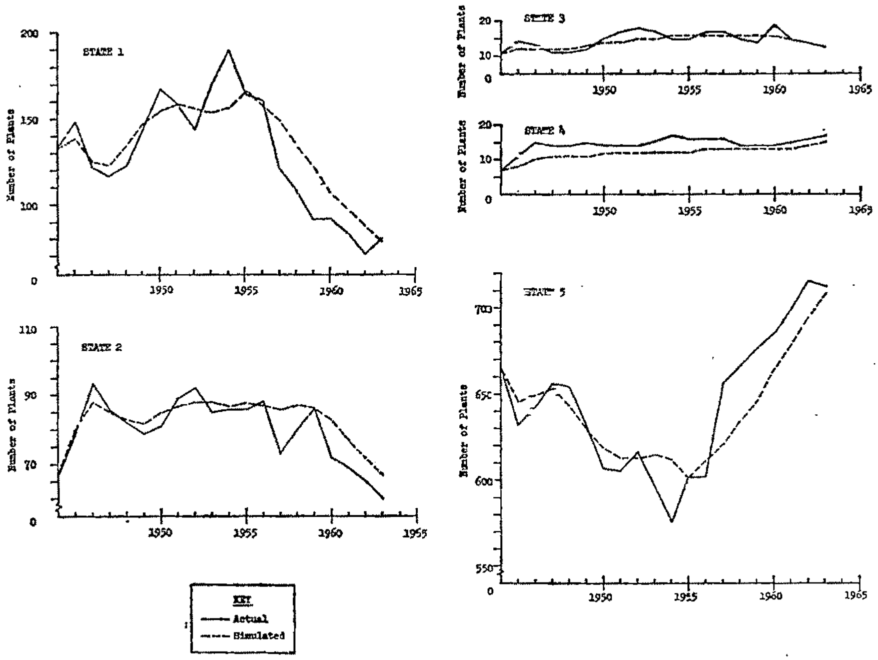

Figure 2. Predictions from the Markov chain model with non-stationary transition probabilities

Another interesting result from the simulation run is the frequency with which the model generated transition probabilities which were either negative or greater than one. In only three of the 19 years did this occur, and in each case element $\hat{p}_{55}$ exceeded one (while element $\hat{p}_{51}$ was negative). The actual numbers generated were 1.001, 1.0058 and 1.0034, respectively. Furthermore, these three years were the last in our series. Although it seems peculiar that this phenomenon occurred in each of the last three years of our series, the magnitude of these numbers hardly leads one to conclude that the model is exploding.

Conclusions

The Markov chain model has been used in several economic analyses with limited regard for implications of the erroneous assumption that the transition probabilities are stationary. Some implications of this assumption were discussed and a modification of the Markov chain model to incorporate a non-stationarity assumption was suggested.

An application of the technique produced results that were considerably more desirable from a predictive standpoint than results obtained from the traditional Markov chain model. This was true in spite of the fact that in one instance the likelihood ratio test indicated stationary transition probabilities.

The empirical analysis in this paper was intended to be illustrative rather than final. Additional work needs to be done to determine the appropriate structural system from which the transition probabilities are generated, as well as the appropriate form of the structural equations. For this purpose, a thorough understanding of the factors responsible for the growth process of firms is essential (including behavioral and financial factors). Such knowledge, unfortunately, does not currently exist.

Once the system from which transition probabilities are generated is known, one would then be in a position to (a) determine the short- or long-run effects of changes in relevant variables necessary to produce the desired short- or long-run effects, and/or (b) obtain other information from the Markov chain model such as attrition rates, mobility indices, etc. [see 3 and 4].

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The Welfare Cost of Alternative Methods of Protecting Raw Wool in the United States

Rachel Dardis and Janet Dennisson

Partial equilibrium analysis was employed to estimate the gain or loss accruing to the United States in adopting alternative methods of protection for raw wool. The cost estimates, which were calculated for 1963, indicated that the economy had gained from the adoption of a partial deficiency payments system in 1954. However, further gains could have been made if the raw wool and compensatory wool products tariffs had been replaced by increased deficiency payments. The cost to the economy of maintaining the present system of protection for raw wool ranged from $13 to $26 million, depending on the particular elasticity of demand used. The results demonstrate the necessity for considering interaction between intermediate and final goods in evaluating alternative methods of protection.

THE United States, as a deficit producer of raw wool, must rely on imports to meet her requirements. Raw wool imports, however, pose a strong threat to the U. S. wool sector, both in terms of quality and price. As a result, governmental protection of the U. S. wool sector is necessary to enable it to compete with imported wool.

Various methods of protection have been in operation in the United States in the postwar period—price support programs, incentive programs, and tariffs on raw wool. The present system of protection for raw wool in the United States is a combination of tariffs and deficiency payments. It was instituted in 1954 with the passage of the National Wool Act, which introduced a new method of support for wool growers [10]. Under this method, raw wool is sold in the open market and cash subsidies (deficiency payments) are granted to growers to compensate for the difference between the open market price and an administratively determined producer price. Prior to 1954, non-recourse loan price support programs had been in effect and had resulted in the accumulation of considerable stocks of raw wool by the Commodity Credit Corporation in 1952 and 1953 [13, p. 36]. The 1954 Act eliminated the cost of acquiring and storing wool and reduced the price of raw wool to the wool textile industry.

The existence of a tariff on imported raw wool, however, means that the textile industry is still unable to purchase raw wool at world market prices. The tariff on raw wool amounts to 25½ cents per pound and raises the open market price of raw wool by this amount.[1] In addition, a compensatory

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[1] During the recent Kennedy round consideration was given to the removal of the raw wool tariff, but no agreement could be reached in time [11, p. 9].

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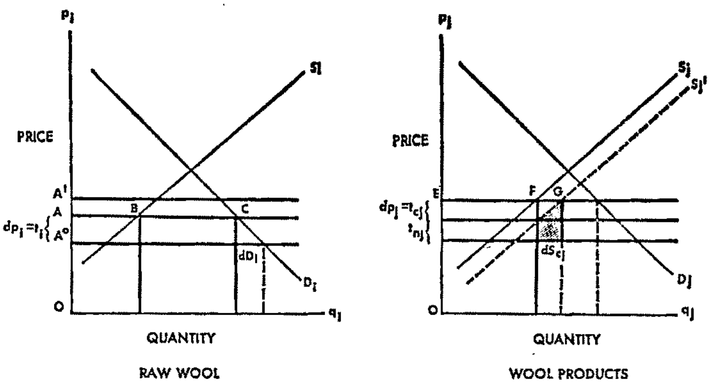
This expression can be further simplified if we remember that raw wool is an essential or limitational input in the production of wool textiles. Thus, the compensatory tariff is related to the raw wool tariff and the amount of raw wool required to produce one unit of output.[5] Under these circumstances,

$$t_{cj} = t_i(AC/EF), \quad \text{and}$$
$$\text{Gain} = t_{nj}dD_{cj} + \tfrac{1}{2}t_{cj}dD_{cj}.$$

This gain is represented in Figure 2 by the shaded area. It may also be considered the loss to the economy from continuing to employ the present system of protection for raw wool, a loss which could be removed with the adoption of a complete deficiency payments system for raw wool. It is interesting to note that the adoption of this new system would not interfere, in any way, with producers' surplus in either the raw wool or wool products sectors.

Case II: Removal of the raw wool tariff only (Figure 3)[6]

In this case, only the raw wool tariff is removed. It is replaced by increased deficiency payments of AA^0 per unit of production in the raw wool sector, resulting in a loss to the government of t_iAC, as in Case I.



RAW WOOL

WOOL PRODUCTS

Figure 3. Case II: Removal of the raw wool tariff only

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[5] For example, if 2 pounds of raw wool are required to produce one pound of wool products, then a tariff change of $0.25 for raw wool requires a tariff change of $0.50 for wool products. The determination of the compensatory tariff for various wool products is, in fact, based on this principle.

[6] The fact that the compensatory and raw wool tariffs are related does not necessarily imply that both tariffs will be discontinued at the same time. The wool products manufacturer might, in fact, seek the removal of the raw wool tariff as a method of increasing protection of the wool products industry. Case II is also of interest in that it demonstrates that a tariff removal need not necessarily result in a welfare gain to the economy if the protected good is an input in an industry that is itself protected.

In the wool products sector, the removal of t_i has again resulted in the shift of S_j to S_j'. Unlike Case I, however, there is an increase in producers' surplus of $t_{cj}(EF+\frac{1}{2}dS_{cj})$, since the wool products price has not been reduced. The continuance of the compensatory tariff in this instance also means that there is no gain in consumers' surplus. There is, however, a loss in custom revenue of $(t_{cj}+t_{nj})dS_{cj}$, as domestic production responds to lower input prices. Combining the losses in both sectors and subtracting from them the gain in producers' surplus in the wool products sector, we obtain

$$\begin{aligned}\text{Cost} &= t_iAC + (t_{cj} + t_{nj})dS_{cj} - t_{cj}(EF + \tfrac{1}{2}dS_{cj})\\ &= t_iAC + t_{nj}dS_{cj} + \tfrac{1}{2}t_{cj}dS_{cj} - t_{cj}EF\\ &= t_{nj}dS_{cj} + \tfrac{1}{2}t_{cj}dS_{cj}, \text{ assuming}\\ t_{cj} &= t_i(AC/EF).\end{aligned}$$

The cost in this case reflects the cost to the economy when the compensatory tariff is retained in spite of the removal of the raw wool tariff. This cost arises from increased domestic production in response to lower input prices. The results of Case II differ from those of Case I in that a net loss rather than a net gain is endured by the economy. The only gainers in Case II are the producers of wool products, and their increase in welfare is purchased at the expense of the rest of the economy.

In this context, relative cost, or cost as a percentage of the change in producers' surplus in the wool products sector, is of interest. It may be expressed as follows:

$$\text{Relative Cost} = \frac{t_{nj}dS_{cj} + \frac{1}{2}t_{cj}dS_{cj}}{t_{cj}EF + \frac{1}{2}t_{cj}dS_{cj}} = \frac{t_{nj}dS_{cj} + \frac{1}{2}t_{cj}dS_{cj}}{t_{cj}S_j + \frac{1}{2}t_{cj}dS_{cj}}\,.$$

Case III. Replacement of deficiency payments by additional tariffs on raw wool and wool products (Figure 4).

In Case I and Case II, we have considered the welfare cost of removing the raw wool tariff while maintaining producers' surplus unchanged in the raw wool sector. In Case III, we consider the welfare cost of employing a complete tariff system for raw wool instead of the present partial deficiency payments system. As illustrated in Figure 4, an additional tariff t_i^* is imposed on raw wool in place of former deficiency payments (AA' per unit of production).

Two outcomes are possible in the wool products sector as a result of the tariff increase. They are: (1) imposition of an additional compensatory tariff to prevent any change in producers' surplus in this sector due to higher input prices; (2) maintainance of wool products price at the former level, in which case there is a reduction in producers' surplus. Since the device of a compensatory tariff is at present employed in the U. S., it

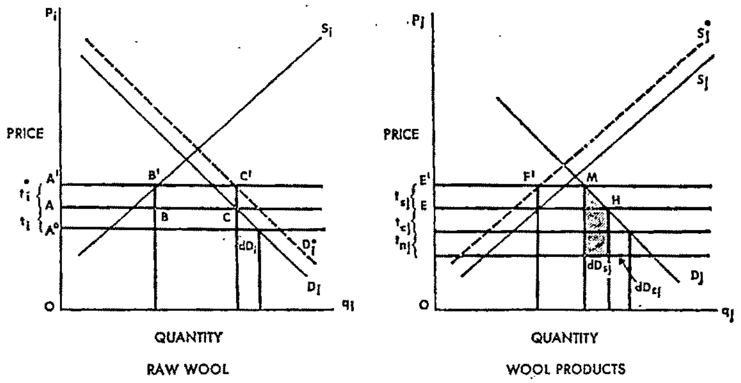

Figure 4. Case III: Replacement of deficiency payments by additional tariffs on raw wool and wool products

seems reasonable to anticipate its continuance in the event of a tariff increase for raw wool. Thus, an additional compensatory tariff t_{sj} is assumed to accompany the additional raw wool tariff t_i^*.

As in Case I, the simultaneous imposition of t_i^* and t_{sj} affects both sectors. Since in this instance, however, we are concerned with tariff imposition rather than tariff removal, the shifts of D_i to D_i^* and S_j to S_j^* are precisely the reverse of those that occurred in Case I.

In the raw wool sector, there is, as usual, no change in producers' surplus. The government, however, experiences a gain of $t_i^*A'C'$ because of the increase in custom revenue $t_i^*B'C'$ and the reduction in deficiency payments $t_i^*A'B'$. In the wool products sector, the gain in government revenue $t_{sj}F'M-(t_{cj}+t_{nj})dD_{sj}$ is offset by the loss in consumers' surplus of $t_{sj}E'M + \frac{1}{2}t_{sj}dD_{sj}$. There is no change in producers' surplus due to the employment of the additional compensatory tariff.

Combining the results of both sectors we obtain:

$$\begin{aligned} \text{Cost} &= t_{sj}E'F' + \tfrac{1}{2}t_{sj}dD_{sj} + (t_{cj} + t_{nj})dD_{sj} - t_i^*A'C' \\ &= \tfrac{1}{2}t_{sj}dD_{sj} + (t_{cj} + t_{nj})dD_{sj}, \text{ assuming} \\ t_{sj} &= t_i^*(A'C'/E'F'). \end{aligned}$$

This represents the cost to the economy when a complete tariff system is adopted in preference to a partial deficiency payments system and no change occurs in producers' surplus in either the raw wool or wool products sector.

Since Case I represents the gain from adopting a complete deficiency payments system, the results of both cases may be combined to compare two alternative methods of protection—deficiency payments and tariffs. In Figure 4, the additional cost of employing a complete tariff system, as opposed to a complete deficiency payments system, is given by

$$\tfrac{1}{2}t_{sj}dD_{sj} + t_{cj}(dD_{sj} + \tfrac{1}{2}dD_{cj}) + t_{nj}(dD_{sj} + dD_{cj}).$$

The Wool Products Supply Model

Whereas elasticity of demand values were based on existing demand studies [4, p. 81; 5, p. 677], elasticity of supply of wool products was obtained by means of a wool products supply model. A multiple linear regression model was used. Both linear and logarithmic versions of the supply equations were tested, and the latter were preferred because they provided a higher degree of explanation and higher "t" test values for most of the variables. Several alternative equations were considered for the wool supply model, with a different set of explanatory variables in each case. The simple least-squares method of estimation was used, since it was assumed that there was only one endogenous variable—wool products supply—in each equation.[7] In all cases, the equations were based on observations for the period 1948–65, and both six-months and annual data were employed.

The supply variable was the production of wool products—wool tops, yarns, broadwoven fabrics, blankets, and knit outerwear fabrics. Since raw wool is the basic raw material for the production of such items, mill consumption of raw apparel wool may be used to represent the supply of wool products in the wool textile industry. Supply of wool products was assumed to be determined mainly by four variables: price of wool products and input prices or prices of raw wool, labor, and capital.

A wholesale price index of wool products was used to reflect the price received by wool textile mills. This price index was composed of five categories of wool products: broadwoven fabrics, yarns, wool tops, blankets, and knit outerwear fabrics.[8] Since most firms manufacture to order, prices were unlagged or lagged for six months only. Raw material costs are the most important item in the cost structure of woolen and worsted textile mills [8, p. 72]. Since a satisfactory average price for all grades of raw wool was unavailable, the price of graded Territory shorn wool at Boston was used. This grade of raw wool accounts for a large part of the apparel wool used. A comparable grade of imported wool was also used—Australian 64s, 70s at Boston. This price series included the tariff on imported wool and thus represented the price paid by wool textile mills. Both price series tended to fluctuate parallel with one another, in agreement with the conclusions of Hermie [7, p. 37], thus providing a justification for the use of a representative raw wool price series. And since a time lag exists between the initial sale of raw wool and the production of wool products, prices were lagged from six months to a year.

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[7] With the exception of the unlagged wool products price, the interest rate, and the bank rate, all the independent variables are lagged and thus predetermined. The bank rate and the interest rate may be considered exogenous variables. The price of wool products may also be considered an exogenous variable if we assume, as is the case with raw wool, that it is determined by world prices and the U. S. tariff, both of which are exogenous variables.

[8] The relative importance of the individual categories in the wool products wholesale price index is as follows: broadwoven fabrics 0.62, yarns 0.24, wool tops 0.08, blankets 0.03, and knit outerwear fabrics 0.03 [16, p. 39].

Labor costs are another important cost component in the wool textile industry products [8, pp. 72–73]. They were represented in this study by hourly wages paid by broad-woven fabric mills and were lagged from six months to a year to permit time for adjustment by the wool textile manufacturer. All price series and wages were deflated by the wholesale price index.

The cost of meeting current expenses and purchasing new capital and equipment was measured by the bank rate, which was the average of rates charged on short term loans, and the interest rate, given by the maturity per cent yield of industrial bonds. Phelps [9, p. 25] has discussed the important role that factoring plays in the financial operations of the textile industry so that these two series were assumed to include changes in the cost of services rendered by factoring firms.

The variables used in the wool supply model were as follows:

y is wool product production, no lag
x_1 is wholesale price index for wool products deflated by the wholesale price index for all commodities (WPI), no lag
x_2 is wholesale price index for wool products deflated by WPI, 6-months lag
x_3 is price of Territory fine wool, deflated by WPI, 6-months lag
x_4 is price of Australian 64s, 70s wool, deflated by WPI, 6-months lag
x_5 is bank rate, no lag
x_6 is bank rate, 6-months lag
x_7 is interest rate, no lag
x_8 is hourly wages, deflated by WPI, 1-year lag.

All variables are in logarithmic form.

The eight equations finally selected are given below. The variables without primes pertain to 6-month data; the variables with primes, to annual data.[9] Standard errors are enclosed in parentheses below their respective parameter estimates. The coefficients of multiple determination and the Durbin-Watson(d) statistics are also given:

$$\begin{array}{llll} (1) & y = 2.3242 + 3.1810x_2 & - 1.5535x_3 & - 0.9739x_5 \\ & \qquad\qquad\quad (0.9975) & \quad (0.4382) & \quad (0.1292) \\ & \qquad\qquad\quad R^2 = 0.755 & & \quad d = 1.43 \end{array}$$

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[9] Due to multi-collinearity, it was not possible to include wages with either the bank rate or the interest rate. In the case of 6-months data, the bank rate was found to provide a more satisfactory explanation than either wages or the interest rate. This may reflect, in part, investment policies of the textile industry in the postwar period.

(2)
$$y = 2.5729 + 2.7959x_2 - 1.3286x_3 - 8.4641x_6$$
$$(0.9434) \qquad (0.4138) \qquad (0.1548)$$
$$R^2 = 0.715 \qquad d = 1.52$$

(3)
$$y = 6.9173 + 2.5444x_2 - 1.4688x_4 - 1.0688x_5$$
$$(0.6582) \qquad (0.3227) \qquad (0.1242)$$
$$R^2 = 0.792 \qquad d = 1.45$$

(4)
$$y = 7.1100 + 2.1034x_2 - 1.1940x_4 - 0.9342x_6$$
$$(0.6426) \qquad (0.3142) \qquad (0.1534)$$
$$R^2 = 0.742 \qquad d = 1.47$$

(5)
$$y' = 8.9496 + 2.1347x_1' - 0.9082x_3' - 0.7312x_5'$$
$$(0.6191) \qquad (0.2542) \qquad (0.1646)$$
$$R^2 = 0.857 \qquad d = 1.91$$

(6)
$$y' = 9.3753 + 2.8251x_1' - 1.2524x_3' - 0.8976x_7'$$
$$(0.6580) \qquad (0.3178) \qquad (0.2503)$$
$$R^2 = 0.820 \qquad d = 1.86$$

(7)
$$y' = 8.2608 + 3.1946x_1' - 0.9853x_3' - 1.5372x_8'$$
$$(0.6707) \qquad (0.3032) \qquad (0.4672)$$
$$R^2 = 0.805 \qquad d = 2.07$$

(8)
$$y' = 8.6118 + 1.6736x_1' - 0.4970x_4' - 1.2001x_8'$$
$$(0.6366) \qquad (0.5332) \qquad (0.5833)$$
$$R^2 = 0.678 \qquad d = 1.99$$

Estimates of the coefficients, with the exception of equation (8), were found to be statistically significant at the 1 percent level. All the signs of the coefficients are satisfactory and are in agreement with economic theory—a positive relationship between supply and the price of its product, with an inverse relationship between supply and input prices. The Durbin-Watson test for serial correlation produced results that were inconclusive in the case of 6-months data and showed no evidence of serial correlation for annual data.

Elasticity values estimated by using 6-months data were fairly similar to those estimated by means of annual data. Values were elastic in all instances and ranged from 1.67 to 3.19.

Measurement of the Cost of Alternative Methods of Protection for Raw Wool

The gain or loss arising from the adoption of alternative methods of protection for raw wool was examined for 1963, considered to be a representative year for the period after 1961 because standard tariff rates for wool products have been employed since then.

Case I. Gain from removing the raw wool and compensatory tariffs

The net gain was defined as

$$t_{nj}dD_{cj} + \tfrac{1}{2}t_{cj}dD_{cj}$$

where

t_{nj} = net tariff on wool products
$t_{cj} = dp_j$ = compensatory tariff on wool products

dD_{cj} = change in domestic consumption of wool products when the compensatory tariff is removed.

Then

$$\begin{aligned} dD_{cj}(t_{nj} + \tfrac{1}{2}t_{cj}) &= \frac{dD_{cj}}{dp_j}\, dp_j(t_{nj} + \tfrac{1}{2}t_{cj}) \\ &= \epsilon_j \frac{D_j}{p_j}\, t_{cj}(t_{nj} + \tfrac{1}{2}t_{cj}) \\ &= \epsilon_j V^D_j k_{cj}(k_{nj} + \tfrac{1}{2}k_{cj}) \end{aligned}$$

where

ϵ_j = elasticity of domestic demand for wool products
$V^D{}_j$ = value of domestic consumption of wool products
$k_{nj} = t_{nj}/p_j$
$k_{cj} = dp_j/p_j = t_{cj}/p_j$

and

p_j = domestic price of wool products in 1963.

Table 1 gives the gain from replacing the present partial deficiency payments system by a complete deficiency payments system.

The variables k_{nj} and k_{cj} were obtained by dividing duties collected under the net and compensatory tariffs, respectively, by the total value of imports

Table 1. Gain from removing the raw wool and compensatory tariffs (1963)

ϵ_j	V_j^D	k_{cj}	k_{nj}	Gain	Gain as a percentage of the value of domestic consumption
	million dollars			million dollars	
0.5	1,291	0.0805	0.2142	13.17	1.0
1.0	1,291	0.0805	0.2142	26.34	2.0

including compensatory and net tariffs. Summation of the value of imports and the value of domestic shipments provided a measure of V_j^D. Two values of elasticity of demand— 0.5 and 1.0—based on previous studies of demand for raw wool, were employed.[10] Estimates of the gain ranged from \$13 to \$26 million and accounted for 1–2 percent of the value of domestic consumption. This gain may also be considered the cost to the economy of employing a partial rather than a complete deficiency payments system.

Case II. Cost of removing the raw wool tariff only

The cost was defined as

$$\begin{aligned} & t_{nj} dS_{cj} + \tfrac{1}{2} t_{cj} dS_{cj} \\ & \quad = \frac{dS_{cj}}{dp_j} dp_j \left(t_{nj} + \tfrac{1}{2} t_{cj}\right) \\ & \quad = \eta_j \frac{\bar{S}_j}{p_j} t_{cj} \left(t_{nj} + \tfrac{1}{2} t_{cj}\right) \\ & \quad = \eta_j V_j^S k_{cj} \left(k_{nj} + \tfrac{1}{2} k_{cj}\right) \end{aligned}$$

where

V_j^S = value of domestic production of wool products,

η_j = elasticity of domestic supply of wool products and the other terms are as defined earlier.

In a similar manner, relative cost, or cost as a percentage of the change in producers' surplus, reduces to

$$\frac{\eta_j k_{nj} + \tfrac{1}{2} \eta_j k_{cj}}{1 + \tfrac{1}{2} \eta_j k_{cj}}$$

Table 2 gives the cost when the raw wool tariff only is removed. The wool products supply model furnished the necessary supply elasticities. For purposes of comparison, cost estimates for η_j equal to unity were also obtained.

The cost of protection is considerable, both in absolute and relative terms. Absolute cost ranged from \$23 to \$75 million; relative cost, or cost as a percentage of the change in producers' surplus, ranged from 24 to 72 percent, depending on the elasticity value used. Thus, each dollar gained by the

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[10] Studies by Donald [4, p. 81] and Ferguson and Polasek [5, p. 677] give elasticities of demand for raw wool of 0.32 and 0.56 respectively. If we assume that the elasticity of demand for raw materials is less than the elasticity of demand for products manufactured from the same raw materials, such estimates provide a lower limit on the elasticity of demand for wool products. See Foote's discussion of elasticities of demand at various marketing levels [6, pp. 106–108]. The existence of many substitutes for wool products, owing to the growth of the man-made fiber industry, and the importance of raw material costs to the consumers of wool textile products also justify the belief in a relatively elastic demand for wool products.

Table 2. Cost of removing raw wool tariff only (1963)

Eq.	η_j	V_j^S	k_{cj}	k_{nj}	Cost	Cost as a percentage of change in producers' surplus
		million dlolars			million dollars	
—	1.00	1,145	0.0805	0.2142	23.36	24
8	1.67	1,145	0.0805	0.2142	39.01	40
4	2.10	1,145	0.0805	0.2142	49.06	49
5	2.18	1,145	0.0805	0.2142	50.92	51
3	2.54	1,145	0.0805	0.2142	59.33	59
2	2.80	1,145	0.0805	0.2142	65.41	64
6	2.83	1,145	0.0805	0.2142	66.11	65
1	3.18	1,145	0.0805	0.2142	74.28	72
7	3.19	1,145	0.0805	0.2142	74.52	72

wool textile industry under this new method of protection would cost the economy from 24 to 72 cents. The high cost is really a reflection of added protection of the domestic wool textile industry, since the compensatory tariff is continued in spite of the removal of the raw wool tariff. Adoption of this method of protection brings a net loss rather than a net gain to the economy, although it does benefit the wool products producer.

Case III. Cost of replacing deficiency payments by additional tariffs on raw wool and wool products

The cost was defined as

$$\tfrac{1}{2}t_{sj}dD_{sj} + (t_{cj} + t_{nj})dD_{sj}$$

where

$t_{sj} = dp_j =$ additional (compensatory) tariff on wool products

$dD_{sj} =$ change in domestic consumption of wool products when t_{sj} is employed.

This may be rewritten as

$$\frac{dD_{sj}}{dp_j}\, dp_j(\tfrac{1}{2}t_{sj} + t_{cj} + t_{nj})$$

$$= \epsilon_j \frac{D_j}{p_j} t_{sj}(\tfrac{1}{2}t_{sj} + t_{cj} + t_{nj})$$

$$= \epsilon_j V^D{}_j k_{sj}(\tfrac{1}{2}k_{sj} + k_{cj} + k_{nj})$$

where $k_{sj} = t_{sj}/p_j$ and the other terms are as defined earlier.

Table 3 gives the cost of replacing the present partial deficiency payments system by a complete tariff system. The additional compensatory

Table 3. Cost of replacing deficiency payments by additional tariffs on raw wool and wool products (1963)

ϵ_j	V_j^D	k_{cj}	k_{nj}	k_{sj}	Cost	Cost as a percentage of the value of domestic consumption
	million dollars				million dollars	
0.5	1,291	0.0805	0.2142	0.0947	20.92	1.6
1.0	1,291	0.0805	0.2142	0.0947	41.83	3.2

tariff k_{sj} was obtained by comparing average prices received by farmers with support prices for raw wool and relating this difference to the wool products price. As in Case II, the economy endures a net loss when it adopts this method of protection. The loss ranged from $21 to $42 million and accounted for 2 to 3 percent of the value of domestic consumption. This result also provides an estimate of the gain to the economy when a partial deficiency payments system rather than a complete tariff system was adopted in 1954. When we combine the results of Case I and Case III, we can compare two methods of protection—complete deficiency payments system and complete tariff system. The difference between the two methods ranges from $34 to $68 million, a difference that is accounted for by the absence of a consumption cost under the deficiency payments system.

Conclusions

The gain or loss resulting from the adoption of three alternative methods of protecting raw wool in the United States was calculated for the year 1963. In all cases, producer price (and hence, producers' surplus) was maintained unchanged in the raw wool sector.

The gain from the removal of the raw wool and compensatory tariffs (Case I) varied from $13 to $26 million and from 1 to 2 percent of the value of domestic consumption of wool products, depending on the particular elasticity of demand used. When only the raw wool tariff was removed, however, the economy endured a loss rather than a gain, ranging from $23 to $75 million. This cost arose from the stimulation of domestic production of wool products in response to lower input prices and was related to elasticity of supply of wool products. Relative cost, or cost as a percentage of the change in producers' surplus, in the wool products sector ranged from 24 to 72 percent, depending on the particular elasticity of supply used. Thus, every dollar transferred to the wool products sector by this method of protection cost the economy from 24 to 72 cents in terms of resource misallocation. The results of Case II indicate the necessity for removing both the raw wool and compensatory tariffs if the economy is to obtain a net gain.

The replacement of the present partial deficiency payments system by a complete tariff system (Case III) cost the economy from $21 to $42 million, or from 2 to 3 percent of the value of domestic consumption. This result is of interest in that it indicates the gain in 1963 to the economy in utilizing a partial deficiency payments system in place of a complete tariff system as a method of protecting the raw wool producer. Case I, on the other hand, indicates the potential gain foregone by the economy in 1963 in not employing a complete deficiency payments system. The combined results of Case I and Case III give an additional cost of $34 to $68 million when tariffs rather than deficiency payments are used to protect the raw wool sector. This cost is calculated on the basis of unchanged producers' surplus in either sector and reflects the absence of a consumption cost under a complete deficiency payments system.

The limitations of the present study must be acknowledged. In addition to the usual limitations of partial equiliblium analysis, it neglects the dynamic effects of trade restrictions. Its scope is also limited to the impact of alternative methods of protection for raw wool on the economy. The cost to the economy of maintaining protection in either the raw wool or wool products sector was not investigated; such a study undoubtedly needs to be done.

The most important result of the study is the demonstration of the relationship between method and cost of protection. In particular, the results of Case I provide us with an estimate of the cost of maintaining the present system of protection for raw wool—a cost which could be removed without changing producers' surplus in either the raw wool or wool products sector.

Changes in the existing method of protection may also have implications for the wool sector in the long run. It is possible that the higher price of raw wool has provided an incentive for the substitution of synthetics for wool [1, p. 144]. Such a development cannot be considered to be in the best interests of the domestic wool producers, since the entire clip of the domestic producer is sold to domestic mills [12, p. 12]. Thus, given the existence of a domestic wool support program, both the wool growers and the economy have much to gain by eliminating the raw wool and compensatory tariffs and substituting increased deficiency payments.

Appendix

Data Used in the Wool Products Supply Model

The supply of wool textile products was represented by mill consumption of apparel wool (U.S. Department of Agriculture, *Wool Statistics and Re-*

lated Data: 1920–64, and *Supplement for 1965*, ERS, Stat. Bul. No. 363, July 1965, August 1966, Table 84).

The wholesale price indexes for wool products and for all commodities were the indexes prepared by the U.S. Department of Labor, Bureau of Labor Statistics (U.S. Department of Commerce, *Survey of Current Business*, and U.S. Department of Commerce, *Business Statistics: A Supplement to Survey of Current Business.*) Two series were employed to estimate the price of raw wool to the mills. The first series was graded territory shorn wool, fine good French combing and staple, clean basis, Boston, (U.S. Department of Agriculture, *op. cit.*, Table 168). The second series was Australian wool, 64's, 70's, good top-making, clean basis, Boston, duty-paid, (U.S. Department of Agriculture, *op. cit.*, Table 200).

Labor costs were represented by average hourly earnings of production and related workers in the woolen and worsted division and by average hourly earnings of production workers in weaving and finishing broad woolens (Special Communication from Robert O. Dorman, U.S. Department of Labor, Bureau of Labor Statistics and U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings Statistics for the United States, 1909–65*, BLS Bul. No. 1312-3, 1965). Both series overlapped for a period of three years (1958–60) and, since they were almost identical, were combined to form a single series.

The interest rate used was the yield to maturity of high grade industrial bonds (Standard and Poors' Corporation, *Standard and Poors' Trade and Securities Statistics: Security Price Index Record.*) The remaining variable employed to estimate cost of capital, was the bank rate on business loans in nineteen cities in the United States (U.S. Department of Commerce, *Business Statistics.*)

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Capitalized Values of Tobacco Allotments and the Rate of Return to Allotment Owners*

JAMES A. SEAGRAVES

Tobacco allotments have been salable only along with the farms to which they are attached. Multiple regression allows one to isolate that part of total land value accounted for by allotments. Capitalized values of flue-cured tobacco allotments were estimated for the period 1934–62. The ratio of annual earnings to these capitalized values, or the rate of return, fell from about .75 in the years 1944–46, when the program was first really effective, to a level of .16 for the period 1957–62. This decline reflects a dramatic increase in investor confidence in the future of the tobacco program and places tobacco allotments, which are widely thought to be highly profitable as monopoly rights go, in a class of relatively riskless investments. Government programs that reduce the risk of farm ownership are bound to increase the value of the assets and thereby reduce the rate of return. The rate of return allows us to predict the fall in capitalized value that will accompany future changes in expected income.

THIS study is not meant to be a defense of or an attack upon the tobacco program. It began as an effort to understand the distributive process. The results conflict sharply with the beliefs of those who argue that labor has benefited from the program. Even though owner-operators supply the majority of the labor, it does not follow that opportunity returns to labor are therefore inseparable from returns to other factors. Nor is there any logical reason for a restriction of production to increase the demand for labor; and certainly nothing has been done under the program to reduce the supply of workers. North Carolina has more farmers than any other state, and many of them grow tobacco. The program clearly has helped the State, and some of its land owners, a great deal.[1]

The main results of the study are summarized in Table 1. Independent estimates were obtained for the annual net revenue and the capitalized value of the right to produce a pound of flue-cured tobacco. Average values of these series, converted to constant dollars, were then calculated for approximately three decades, between 1934 and 1962. Net revenues were relatively constant during this period, increasing from 19.2 cents per

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[1] Agricultural economists have made a number of worthwhile studies of the tobacco program. These fall into roughly four categories: (a) explaining political forces and program alternatives; (b) social costs, including aggregate effects on exports; (c)

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Table 1. Price, net revenue to allotments, capitalized values of allotments, and rates of return on allotment ownership, for flue-cured tobacco in the "New Belt" of Eastern North Carolina, 1934-62, in constant 1957-59 dollars

Years averaged together	Price[a]	Net revenue[a]	Capitalized values[a]	Rate of return[b]
		cents per pound		
1934–42	49.2	19.2	34.5	.56
1943–52	64.0	25.6	63.5	.40
1953–62	58.2	23.7	151.2	.16

[a] Deflated by Dept. of Labor consumer price index before averages were calculated.
[b] Net revenue divided by capitalized values.
Source: Tables 2 and 5.

pound in the first decade of the program to 25.6 cents per pound for 1943–52, and falling to 23.7 cents per pound in the most recent decade; but capitalized values steadily increased from 34.5 cents per pound to $1.51 per pound in the last decade studied. How is it possible that net revenues fell 7 percent between 1943–52 and 1953–62, while the amount paid for the right to grow tobacco increased 138 percent? Why did the rate of return on the capitalized value of tobacco allotments fall as drastically as indicated in Table 1?

One reason investors bid up the price of these allotments was that con-

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predicting rational firm behavior in the light of proposed program changes; and (d) distribution of program benefits among farm resources. This article belongs in (d). To describe briefly some of these studies, by categories: (a) Williamson and Toussaint [29] gave us a picture of the strong political support for the tobacco program; and Williamson and Brooks [28] explained how poundage controls could work some five years before they were adopted. (b) Johnson [15] measured social costs to the U. S. of restricted production and found them to be more than offset by the increased value of exports. He derived an elasticity of —2.0 for our export demand from assumptions about demand and foreign supply elasticity. Capel [4] used time series data from 11 importing countries and estimated that foreign demand for our exports fell within the range of —0.61 to —2.27. (c) Acreage reserve was studied by Coltrane [6]. The program was short-lived and had little impact. Lease and transfer provisions have been much more significant. Bradford and Toussaint [3] studied the possibilities for transferability before the program actually started. Their provisions concerning price per pound at which allotments would be traded were substantiated by surveys reported by Bordeaux, Hoover and Toussaint [2]. Hoover [13] has obtained estimates of rents paid per pound for all the flue-cured tobacco producing regions from Virginia to Florida. (d) Mason [18] was one of the first economists to estimate value of tobacco allotments and discuss distributional implications. He estimated that an acre of tobacco allotment added $300 to $600 to the value of a farm in 1945. Maier, Hedrick and Gibson [16] used multiple regression techniques with actual farm sales in Pittsylvania county, Virginia, and in certain Eastern North Carolina counties to estimate the values of flue-cured tobacco allotments per acre for 1954–1957. Reductions in allotment acres were associated positively with increases in allotment values per acre. Allotment values were lower where non-farm wages were higher. Hedrick [10] estimated landlord and cropper tenant incomes for the period 1922–1966 from survey data. A recently issued USDA Bulletin by Hedrick, Tolley, and Bach [11] summarizes this study.

Table 2. Prices and estimated net revenues from flue-cured tobacco in the "New Belt" of Eastern North Carolina, 1930–1962

Year	Yield[a]	Price[a]	Wage rate[b]	Net revenue[c]		Constant 1957–59 dollars[d]	
						Price	Net revenue
	pounds per acre	cents per pound	cents per hour	dollars per acre	dollars per pound	cents per pound	
1930	760	13.4	16	15.01	.02	23.0	3.4
31	700	9.0	13	18.23	.026	17.0	−4.9
32	630	12.5	8	3.53	.006	26.0	1.2
33	830	16.4	7	56.41	.068	36.4	15.1
34	905	29.7	10	169.44	.187	63.2	39.8
1935	960	20.9	10	92.52	.096	43.5	20.0
36	760	23.1	11	54.89	.072	48.1	15.0
37	925	25.1	12	98.75	.107	50.2	21.4
38	860	23.0	12	55.63	.065	46.9	13.3
39	1,010	15.4	12	4.51	.004	32.1	0.8
1940	1,120	17.0	12	30.51	.027	34.7	5.5
41	995	29.4	14	115.80	.116	57.6	22.7
42	1,110	37.9	18	218.83	.197	66.5	34.6
43	990	40.3	23	163.45	.165	67.2	27.5
44	1,110	43.0	29	207.61	.187	70.5	30.6
1945	1,120	44.0	33	192.49	.172	69.8	27.3
49	1,150	52.5	38	272.40	.137	77.2	34.8
47	1,205	43.1	43	156.50	.130	55.2	16.2
48	1,285	49.5	45	250.33	.195	58.9	23.2
49	1,245	48.8	44	215.60	.173	58.8	20.8
1950	1,380	56.4	45	371.51	.269	67.2	32.0
51	1,435	55.1	50	251.08	.244	60.5	26.8
52	1,270	50.9	54	178.11	.140	54.7	15.0
53	1,360	57.9	55	302.62	.223	62.2	24.0
54	1,430	55.3	55	295.97	.206	58.8	21.9
1955	1,625	53.0	56	350.79	.220	57.0	23.6
56	1,760	51.8	61	362.10	.206	54.5	21.7
57	1,535	54.8	63	270.85	.176	55.9	18.8
58	1,825	57.7	60	485.61	.266	57.1	26.3
59	1,550	58.7	65	307.08	.198	57.5	19.4
1960	1,980	61.2	65	597.48	.302	59.4	29.2
61	1,875	65.5	67	592.49	.316	62.2	31.0
62	1,825	59.8	70	429.20	.235	56.9	22.4

[a] North Carolina Department of Agriculture [20 and 21]. Average yields and prices for New Belt, Type 12 tobacco.

[b] United States Department of Agriculture [26]. Based on private communication with J. S. Chappell and D. D. Osburn, 1963, the Crop Reporting Board wage rate estimates were multiplied by 0.926 to estimate wage rates for tobacco production.

[c] Net revenue is estimated by subtracting from total revenue (yield×price) labor costs, variable costs, and land rent. Variable costs and the quantity of labor per acre are based on linear trends connecting the data from these farm management studies: Greene [9], cost data for 1932–1934; Chumney and Vermeer [5], cost data for 1959 and

terms of yields and prices. In 1933 the price was supported, though there were no acreage controls. The combination of higher average yields and a higher price led to much higher net returns. Acreage of tobacco in the New Belt was reduced from 352,000 acres in 1933 to 250,000 acres in 1934. Yields again increased, and prices rose from 16.4 cents per pound in 1933 to 29.7 cents in 1934, again dramatically increasing net returns. In 1939, growers "voted out" acreage control and planted a record 425,000 acres with record yields. The price fell drastically and so did net revenue—to $4.51 per acre from an average of $88.00 per acre for the preceding years. Acreage was limited to 245,000 acres in 1940, and the price increased slightly. Relatively low prices in 1955 and 1956 were associated with high production of "slick" tobacco at a time when darker "bodied" varieties were wanted by the export trade and makers of filter cigarettes. In the net revenue calculation, these lower prices were more than offset by higher yields. When support was withdrawn in 1957 for several high-yielding "slick" varieties of tobacco at the same time that acreage was cut 20 percent, the result was a sizable increase in price and net revenue in 1958.

Tobacco prices since World War II, expressed in constant 1957–59 dollars, generally have stayed within a range of 50–70 cents per pound, focusing in recent years on 55–65 cents (see Table 2). The same stability is characteristic of net revenues per pound, which stayed within a range of 15–35 cents per pound (in 1957–59 dollars) and were generally between 20 and 30 cents per pound. Of course, net revenue *per acre* increased steadily as yields increased during this period, but the net revenue of a given size farm remained fairly constant as the number of allotted acres was declining.

Capitalized Values of Allotments

Because the cost of using data on individual farm sales would have been prohibitive, capitalized values had to be estimated from readily

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labor data for 1956 and 1959; Coutu and Mangum [7], cost data for 1959; and Hole and Vermeer [12], labor data for 1941–1942 and 1957–1958.

Variable costs in dollars per acre are approximated by:

$$VC = 18.61 + 7.71t \quad (t = 0 \text{ in } 1930).$$

Labor in hours per acre is approximated by:

$$\text{Hours} = 376 + 4.97t \quad (t = 0 \text{ in } 1930).$$

Labor increases because yields have been increasing. Rent per acre of cropland without allotment is estimated from the net tobacco income of $9 per acre for the years 1930–1932. After 1933, it was assumed to increase following a linear trend to $25 per acre in 1962, which was approximately the net income from corn. The trend is:

$$\text{Rent} = 9.00 + .55t \quad (t = 0 \text{ in } 1933).$$

[d] The consumer price index of the Department of Labor, as published in *Agricultural Statistics* [25], was used as deflator.

available time series. With the use of Crop Reporting Service and U.S. Census of Agriculture [27] data, it was possible to estimate the value of total farm land minus buildings for each of twenty counties in the "New Belt" of Eastern North Carolina and for each year from 1930 to 1962. These estimates of total land value in each county, together with the recorded pounds of tobacco produced the previous year, provided the basis for using multiple regression to isolate the net value of tobacco allotments per pound.

Using data for 20 counties. Manning [17] estimated allotment values per pound for 1951–1963. His data included the value of farmland, pounds of tobacco production for previous years, acres of cropland, acres of other land, and acres of peanut and cotton allotments. His regression model for explaining W_{ij}, the total value of all farmland in county i and year j, was

$$W_{ij} = \sum_{j=51}^{62} B_{1j} X_{1ij} g_j + \sum_{k=2}^{5} (B_k X_{kij} + C_k X_{kij} t_j) + e_{ij}$$

where

X_{1ij} is the county allotment times the average yield in the previous year in pounds of tobacco,
X_{2ij} is the county cotton allotment in acres,
X_{3ij} is the county peanut allotment in acres,
X_{4ij} is acres of cropland for the county,
X_{5ij} is acres of other land for the county,
e_{ij} is a random error,
t_j is the year, and
$g_j = 1$ for year j and zero otherwise.

(Capital letters B and C represent population or "true" parameters and the corresponding small letters in Tables 3 and 4 represent regression estimates.)

Several of these series were highly intercorrelated, which led to negative coefficients for cotton allotments and other land. As a result, these variables were deleted from the regression equation reported in Table 3. Also, this regression equation was obtained without a constant term since it was difficult to conceive of the meaning that a constant term would have in a value equation that explains the total value of farmland in each county. The results were compared with those of Maier, *et al.* [16], obtained from actual farm sales data for the years 1954–57 for three counties. The estimates were sufficiently similar to allow acceptance of these

Table 3. Regression coefficients for estimating tobacco allotment values from county land values, 1951–1963

Year	Coefficient b_1 (Tobacco allotment values)	t−ratios
	dollars per pound	
1951	.76	8.44
1952	.86	12.29
1953	1.27	15.88
1954	1.05	15.00
1955	1.22	20.33
1956	1.19	19.83
1957	1.51	21.57
1958	1.90	21.11
1959	1.64	20.50
1960	1.95	19.50
1961	1.52	16.80
1962	1.75	17.50
1963	1.86	16.91
Peanut allotment value, b_3, 1900	−$2368.90/acre	3.09
Increment in peanut allot. value, c_3	$ 58.53/acre/year	3.96
Value of cropland, b_4, 1900	−$ 388.91/acre	2.03
Increment in value of cropland, c_4	$ 8.19/acre/year	2.44

Number of observations: 260 (20 counties × 13 years).
Since no constant term was included, the simple correlation coefficient of the predicted and observed values, $r_{y\hat{y}}$, was calculated, instead of R^2, $r_{y\hat{y}} = 0.79$.

aggregate county land value data as a basis for estimating allotment values.

The same procedure was used to obtain the allotment values per pound for 1934–1950, listed in Table 4. In this period, cotton and peanut allotments did not have significant effects on total farm value. When both cropland and other land were included in the same regression, the annual incremental coefficient for other land was negative. The regression equation given in Table 4 was chosen from among several that were tried. A technical bulletin by Seagraves and Manning [23] contains a more complete discussion of data sources and regression equations tried and suggestions for analysis of such combined cross-section and time-series data.

The regression coefficients, which estimate the market value of tobacco allotments per pound, were highly significantly different from zero after 1944 (t-ratios greater than 7) and were relatively insensitive to other variables besides cropland included in other models that were tried. The results from Tables 3 and 4 are brought together in the first column of Table 5. Estimated allotment values per pound fluctuate from year to year mainly because actual yield data for counties in the previous year were used to obtain them. Whenever overall production in these counties was high, the resulting estimate of allotment value for the following year

Table 4. Regression coefficients for estimating tobacco allotment values from county land values, 1934-1950

Year	Coefficient b_1 (Tobacco allotment value)	t – ratios
	dollars per pound	
1934	.050	1.24
1935	.100	2.99
1936	.101	3.35
1937	.217	5.88
1938	.294	7.52
1939	.196	4.91
1940	.238	6.12
1941	.155	4.47
1942	.201	5.69
1943	.150	4.90
1944	.215	7.32
1945	.250	9.44
1946	.334	13.48
1947	.430	17.24
1948	.654	18.08
1949	.681	19.54
1950	.798	21.88
Value of cropland, b_4, 1900	\$42.16/acre	1.62
Increment in value of cropland, c_4	\$ .354/acre/yr.	.57

Number of observations: 340 (20 counties × 17 years).
The constant term was purposely not included in the equation; $r_{y\hat{y}}$ was not calculated. However, the value of R^2 from the computer was .94.

would be low, and vice versa. Hence, much of the extreme fluctuation disappears when allotment values per pound are multiplied by yields for the previous year to obtain the estimates of allotment values per acre. Allotment values per acre increased steadily from about \$500 per acre in 1945–48 to \$3000 per acre in 1959–62. Net revenues were based on current yields and are generally higher when yields are higher. The rate of return is calculated on an annual basis by dividing the net revenue by the capitalized value. The results, presented in Table 5, show a decline proportionate to the increase in allotment values, but the values are somewhat erratic.

Alternative Explanations of the Rate of Return

Two alternative ways to "explain" the indicated decline in the rates of return (Table 5) are (1) smaller discounts for uncertainty, and (2) longer time horizons. Both are based on the present value formula,

$$V_t = \sum_{n=t}^{N} \frac{E(R_n)}{(1+r)^n}, \tag{1}$$

in which V_t is the capitalized value of an asset at time t; $E(R_n)$ is the

Table 5. Capitalized values, tobacco allotments, and annual net revenues expressed in current dollars, and the rate of return, 1934-62

Year	Capitalized values		Annual net revenue	Rate of return[a]
	dollars per pound	dollars per acre	dollars per pound	
1934	.05	42	.187	3.47
1935	.10	90	.096	.96
1936	.10	97	.072	.71
1937	.22	165	.107	.49
1938	.29	272	.065	.22
1939	.20	168	.004	.02
1940	.24	240	.027	.11
1941	.15	174	.116	.75
1942	.20	200	.197	.98
1943	.15	166	.165	1.10
1944	.21	213	.187	.87
1945	.25	278	.172	.69
1946	.33	374	.237	.71
1947	.43	494	.130	.30
1948	.65	788	.195	.30
1949	.68	875	.173	.25
1950	.80	993	.269	.34
1951	.76	1049	.244	.32
1952	.86	1234	.140	.16
1953	1.27	1613	.223	.17
1954	1.05	1428	.206	.20
1955	1.22	1745	.220	.18
1956	1.19	1934	.206	.17
1957	1.51	2658	.176	.12
1958	1.90	2916	.266	.14
1959	1.64	2993	.198	.12
1960	1.95	3022	.302	.16
1961	1.52	3009	.316	.21
1962	1.75	3281	.235	.13

[a] Annual net revenue divided by capitalized values.
Source: Tables 2, 3, and 4.

expected net revenue attributed to the same asset in each future year n; and r is the long-run future discount rate.

Assuming, for purposes of simplicity, that expected annual net revenues for future years are constant and can be represented by one number, $E(R)_t$, for all future years, then the present value formula becomes

$$V_t = E(R)_t \sum_{n=t}^{N} \frac{1}{(1+r)^n} . \tag{2}$$

Further simplifications are commonly applied. For example, an infinite stream of future incomes, $E(R)_t$, is often assumed. In this case,

$$V_t = \frac{E(R)_t}{r}, \quad \text{or} \tag{3}$$

$$r = \frac{E(R)_t}{V_t}.$$

Assuming further that expected future net incomes, $E(R)_t$, are equal to current incomes, R_t, then rates of return (as presented in Table 5) are the same as discount rates, r, with infinite time horizons. Year-to-year fluctuations have been smoothed out of this rate of return series by taking a weighted average of the five most recent years; the results are presented in Table 6. (A preferable procedure may have been to smooth yield series before calculating net revenues and capitalized values.) The smoothed ratios show a steady decline, from $r = .87$ in 1945 to $r = .14$ in 1959. These data suggest that there has been a dramatic reduction in uncertainty, profit, or the return on current investments in tobacco allotments since 1945. The interest rate on new agricultural loans of the Federal Land Bank, also

Table 6. Weighted average of recent rates or return, interest rates on new agricultural loans, and calculated time horizons, 1945-1962

Year	Weighted averages of rates of return[a]	Interest rate on new agricultural loans[b]	Time horizon implied, in years[c]
1945	.87	.04	1.5
6	.82	.04	1.5
7	.65	.04	1.5
8	.50	.04	2.0
9	.38	.04	3.0
1950	.34	.04	3.0
1	.31	.04	3.5
2	.26	.04	4.0
3	.23	.04	5.0
4	.22	.04	5.0
1955	.20	.04	6.0
6	.18	.04	6.5
7	.16	.05	7.5
8	.15	.05	8.5
9	.14	.06	9.5
1960	.14	.06	9.5
1	.16	.06	8.0
2	.16	.06	8.0

[a] Diminishing weights were arbitrarily assigned to the five most recent years, as follows:

$$\bar{r}_t = .30r_t + .25r_{t-1} + .20r_{t-2} + .15r_{t-3} + .10r_{t-4}$$

where the r's are the rates of return from Table 5.

[b] Federal Land Bank rates, as published in *Agricultural Statistics* [25].

[c] Obtained from interest tables for an annuity whose present value is 1.

shown in Table 6, can be thought of as the long-run future discount rate without uncertainty. The difference between the two would be the "net discount for uncertainty," assuming, as a matter of convenience, that the incomes would go on forever.

Alternatively, the rate of return ratio and the riskless rate of interest was used to find (from interest tables) the number of years in the planning horizon, N.[2] The resulting estimates, to the nearest half-year, are presented in the last column of Table 6; they show a lengthening of the time horizon from 1.5 years in 1945 to 9.5 years in 1959. The number of years in the planning horizon was virtually constant from 1957–1962, reflecting practically no change in expectations about the future of the program during this period.

The above two "explanations" of the capitalization process, changes in uncertainty and variable time horizons remain extremely superficial. One source of superficiality is the naive expectations model in which expected future annual incomes are assumed to be equal to current annual income.

$$E(R)_t = R_t.$$

An alternative is to use distributed lags of past incomes based on an expectations model, such as

$$E(R)_t = \left(\frac{R_{t-1}}{E(R)_{t-1}}\right)^{\delta} E(R)_{t-1} e_t, \tag{4}$$

in which the ratio of the actual to expected revenue last year raised to the power δ provides the adjustment factor which is multiplied by last year's expectations to get current expectations of all future incomes, $E(R)_t$. The random error, e_t, is assumed to be multiplicative. This has the same effect as saying that expected future revenue is a weighted average of past revenues. Nonlinear regression procedures were used to estimate δ instead of assuming that it was equal to 1, as was done above. The results

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[2] From equation (2), we have

$$\sum_{n=t}^{N} (1 + r)^n = \frac{E(R)_t}{V_t}.$$

Assuming a rickless interest rate, r, interest tables can be used to find N, the number of years for the annuity of amount $E(R)_t/V_t$, whose present value is 1, *i.e.* V_t. Simply calling N a "planning horizon" does not make it one. Letting all of the uncertainty in $E(R)_t$ be expressed in a smaller N is just as artificial as saying the planning horizon is infinite and letting all of the uncertainty be expressed in r. Objective studies of actual planning horizons and changes in them would require very carefully formulated hypotheses. Incidentally, I found no empirical relationship between presidential or congressional elections and these indicators of uncertainty which would support my hypotheses about the effect of these political changes.

were disappointing mainly because of the deficiencies in the data mentioned earlier.

Predicting Changes in Capitalized Values

The author is interested in the effects of program changes, estimates of elasticities, and statements involving multipliers, such as: "a price increase of 1 cent per pound for tobacco, *ceteris paribus*, is expected to lead to a 6¼ cents per pound increase in allotment values;" or, "a wage rate increase of 10 cents per hour increases production costs 2½ cents per pound and reduces allotment values 15.6 cents per pound." He has concluded that simple synthetic estimates should usually be calculated as a check on regression and other estimates.

With respect to elasticities, Manning [17] developed a simultaneous equations model which should have allowed for all the complex effects of something like a change in tobacco allotments on wages, prices, and allotment values. His data were not precise enough, however, to quantify all of these interactions. He found an elasticity of allotment values with respect to an exogenous tobacco price change (no change in allotments) of slightly less than 1. (The author's synthetic estimate of $dC/dP \cdot P/C$ is $6\frac{1}{4} \cdot 0.60/1.70 = 2.2$.) Manning concluded, "To the extent that prices and time were collinear for the sample there is some confounding of their effects. The sample period [1951–63] was one in which tobacco prices rose about $.10 and the allotment values rose by about $2000 [per acre]. If the interest rate and time variable are aggregated (being very highly correlated), they explain about $1,800 of this increase . . ." [17, p. 31]. Low price variation made it impossible for him to measure the net effects of an exogenous tobacco price change. Still, I believe that this can be a fruitful approach and that it needs to be continued, perhaps with an aggregate demand function and certain other constraints imposed on the system.

Hendrick [10] studied the program's long-run effects on returns to the landlord and the tenant. He found that the returns to cropper labor and the general opportunity returns to labor were "approximately equal in the long run or that tenure arrangements were flexible" [10, p. 71]. This implied that rent was the only residual claimant. Using production theory, he established an equation relating the changes in rent over time to yield, price, wage, labor efficiency, variable costs and their interactions. This allowed him to estimate that tobacco price had a positive effect of $271 and that wage increases had a negative effect of −$295 per acre on tobacco allotment rents in North Carolina between 1925 and 1960. The overall effect for these 35 years was an addition to rent of $177 per acre. He concluded that the elasticity of allotment values with respect to the price of tobacco is about 5 [10, p. 88]. In addition, Hedrick considered the reductions in the number of allotted acres and found that the total rental value of tobacco acres on a typical North Carolina farm would have increased very little from 1947 to 1960. Increases in rent per acre from $109 to $214 were almost completely offset by reductions in allotted acres from 9.2 to 5.3 [10, p. 102].

A percentage distribution of total revenue, based on the budgeted costs of Table 2, is presented in Table 7. Net revenue has been a surprisingly constant proportion of total revenue since the support program began. Labor costs have been increasing steadily since the depression, but there is no logical reason to believe that the tobacco program, which restricted production, would have contributed to these increased wage rates. Land and variable costs have declined in relative importance.

Table 7. Percentage distribution of total receipts among costs and net revenue per acre of flue-cured tobacco in the "New Belt" of Eastern North Carolina, 1930-1962

	Total revenue, dollars per acre in current dollars	Percentage each item is of total revenue			
		Land	Variable costs	Labor	Net revenue to allotment
1930–33	95	9.48	31.79	43.79	14.94
1934–42	237	4.96	33.86	21.78	39.40
1943–52	595	2.85	25.80	31.71	39.64
1953–62	969	2.32	23.81	32.62	41.25

Source: Table 2.

Many of the relevant elasticities or multipliers can be estimated quite simply from three numbers: the elasticity of demand for tobacco, the net revenue percentage, and the ratio of capitalized values to annual net revenues. Johnson [15] estimated the elasticity of domestic plus foreign demand for U. S. production at about −.55. Using this estimate, plus an assumption that net revenues to allotments are 40 percent of total revenue, as in Table 7, one can calculate an elasticity of net revenue (or allotment value) with respect to tobacco price. A 1.0 percent price increase results in a 0.45 percent increase in total revenue (price increases 1.0 percent and quantity decreases 0.55 percent), which is the same as a 0.45 ÷ 0.40 = 1.12 percent increase in net revenue. Assuming that the ratio of capitalized values to net revenues is constant, the percentage change in allotment values as a result of a 1.0 percent increase in price also would be 1.12. (This is for a change in price along one demand curve, as distinct from the elasticities mentioned above, which were based on an exogenous increase in demand.)

If one wanted to calculate an absolute multiplier, as opposed to an elasticity, knowledge of the price/earnings ratio also would be necessary. A price/earnings ratio of 6.25 is simply the reciprocal of the rate of return of 0.16 in Table 6. What would be the effect of a 10 cent per hour increase in the wage rate on allotment values? The labor requirement is about 1/4 hour per pound, so that net revenue will be reduced by 2 1/2 cents. This results in a decrease in allotment values of 6.25 (2 1/2 cents), or 15.6 cents per pound.

The price/earnings ratio is assumed to be stable in the above example. One also could imagine changes which affect the general level of confidence in the program. In such cases, one would need to quantify the change in the price/earnings ratio in order to calculate these elasticities and multipliers.

Conclusions

Budgeting procedures provide estimates of the annual net earnings per pound of tobacco allotment that are reasonably close to the actual rents paid.[3] Different regression procedures and data sources provide consistent estimates of the capitalized value of allotments. Combining these, the rate of return gives a measure of the distributive impact of the tobacco program from the standpoint of new investors or any existing farmers who plan to retain ownership of allotments during the coming year. Ownership of a farm can be thought of as holding a portfolio of assets, each with distinctive elements of risk and personal utility. The positive relationship between rates of return and risk in the aggregate has been explained by Farrar [8], Sharp [24], and others. Government programs that reduce the risks of farming are almost bound to increase the value of assets and thereby reduce the rate of return on investments in farming.

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Nonproducer Cooperative Interests and the Antitrust Laws*

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Cooperatives' ability to enlist the assistance of non-producer and/or noncooperative firms in their marketing efforts has been severely limited by recent Supreme Court decisions. In *Case-Swayne Co. v. Sunkist Growers, Inc.*, the court held that Sunkist, with nongrower members, was not a Capper-Volstead cooperative and therefore was not entitled to Capper-Volstead exemption from prosecution under section 1 of the Sherman Act. Although the case provides a much needed guide for cooperative activity, it did not explicitly define what constitutes a producer. Nor did it provide an indication of the extent to which a cooperative can control or increase its share of the market and still not be held in violation of section 2 of the Sherman Act.

THE EXTENT to which cooperatives are able to organize to exercise influence upon the marketing of farm products and to enlist the assistance of nonproducer and/or noncooperative firms in their marketing efforts has an important influence upon the cooperative movement. A recent United States Supreme Court decision—*Case Swayne Co. v. Sunkist Growers, Inc.* [5]—helps to clarify some of these questions. At the same time, it raises new questions with respect to the definition of a producer and the extent of nonproducer participation allowed in a cooperative under the Capper-Volstead Act. This article is designed to provide some insight and to promote discussion of these questions.

In *Case-Swayne v. Sunkist*, the plaintiff (Case-Swayne) brought action seeking treble damages under section 4 of the Clayton Act [5] from Sunkist for alleged monopoly and attempt to monopolize in violation of sections 1 and 2 of the Sherman Act [10]. Case-Swayne was an independent manufacturer of single strength orange juice. It accused Sunkist of having conspired with its noncooperative packing house members to limit the quantity of product citrus fruit available to Case-Swayne.

Sunkist, a federated cooperative, controlled approximately 70 percent of all of the oranges produced in California and 67 percent of the oranges diverted to product use. All of the Sunkist local affiliates contract with Sunkist to market all of their fruit. The local associations, in turn, contract with their growers.

Case-Swayne had no problem purchasing product oranges when Sunkist operated none of its own processing facilities. However, when juice and other citrus products became profitable, Sunkist set up its own pro-

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cessing facilities. It then sold to independent processors, such as Case-Swayne, only when it was unable to process its own fruit. As Sunkist increased its processing capacity, Case-Swayne found it increasingly difficult to obtain fruit. The alleged violations of the Sherman Act arose out of the combination of Sunkist's dominant control of the California-Arizona orange crop, its vertical integration, its revealed preference for processing oranges in its own facilities, and the inability of the plaintiff to purchase oranges from Sunkist at competitive prices.

Sunkist contended that its conduct was "legitimate, cooperative activity and not undertaken in an unlawful manner or for an unlawful purpose" [4, p. 495]. In addition, Sunkist contended that it was a cooperative association of "persons engaged in the production of agricultural products" within the meaning of the Capper-Volstead Act [6] and therefore could not be held for an intra-organizational conspiracy to restrain trade in violation of section 1 of the Sherman Act.

Case-Swayne argued that Sunkist was not exempt from prosecution under section 1 of the Sherman Act, because approximately 13 percent of the volume of the Sunkist organization was with local association members who were private profit making corporation and partnership packing houses not engaged in the production of fruit [4, p. 460]. These local associations contracted with growers to handle their production on a cost-plus basis. The locals then contracted with Sunkist to market their products. These arrangements with the noncooperative locals, of course, gave Sunkist control over a larger proportion of the volume of oranges marketed.

The district court granted Sunkist's motion for a directed verdict[1] on the premise that the relevant market was national in scope and that evidence was not shown of an illegal monopoly. The court of appeals reversed the directed verdict, holding that there was sufficient evidence to submit to the jury the questions of:

1. Whether the relevant product market was product oranges and the relevant geographic market Southern California-Arizona; and
2. Whether Sunkist had wrongfully exercised and intentionally attempted to monopolize in violation of section 2 of the Sherman Act[2] [4, p. 459].

In addition, the court of appeals held that the contracts with the agency associations were independent contracts for legitimate objectives of marketing and processing. In so holding, the court noted that:

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[1] "A motion to direct a verdict is an application to the court by one of the parties for entry of judgment in its favor" [11, p. 262].

[2] Note that the court of appeals did not find that Sunkist had engaged in any of the alleged acts of monopoly—only that the evidence as a whole indicated that the case should have been submitted to a jury.

1. The agency associations did not participate in the gain or loss involved in marketing fruit through Sunkist; and
2. Sunkist was an association of producers organized under the Capper-Volstead Act and therefore "may make the necessary contracts and agreements . . . for . . . collectively processing, preparing for market, handling and marketing . . ." their products [4, p. 460].

The question of whether Sunkist, with non-grower agency association members, was an association of persons engaged in the production of agricultural products within the meaning of the Capper-Volstead Act was the sole issue in the Supreme Court appeal. The Supreme Court held that Sunkist, with non-grower members, was not a Capper-Volstead cooperative and therefore was not entitled to Capper-Volstead exemption from prosecution under section 1 of the Sherman Act. [5, L. Ed. 2d, p. 623].

In its decision, the court noted that Congress explicitly stated that a cooperative cannot seek to enlarge its market share by enlisting the membership of nonproducer organizations. Trade is restrained in this case because the nonproducer organizations are eliminated as competitors both in the grower market for produce and in the fresh and/or processed fruit market.

In so holding, the court noted that in cases where the parties to the antitrust suit are marketing cooperatives whose members are engaged in the production of agricultural products, cooperatives have been allowed to pursue their efforts to gain market control as long as predatory practices were not used to exclude other firms or producers from markets. In *Sunkist Growers, Inc. et al. v. Winckler and Smith Citrus Products Co.* [12], the court rejected an intraenterprise conspiracy contention that Sunkist had conspired with a wholly owned subsidiary and with a separate stock company owned by the Sunkist local association members. Even though Sunkist controlled about 70 percent of the California-Arizona citrus market, the court found that agreements among the three cooperative organizations were within the protection of the Capper-Volstead Act.

In cases where mergers, acquisition, or restrictive market practices involve a cooperative and a noncooperative firm, a standard of legality much closer to that applied to other firms has been applied. In *Maryland-Virginia Milk Producers Association v. U.S.* [9], the court held that a milk marketing cooperative had violated both the Sherman Act and section 7 of the Clayton Act when it attempted to exclude competing sources of milk by purchasing the largest noncooperative milk dealer in the Washington, D.C. market. Similarly, in *U.S. v. Borden Co.* [14], the court held that a price fixing conspiracy between a Capper-Volstead cooperative, milk distributors, labor unions, and others was illegal. In so holding, the court noted that the right of agricultural producers to unite under the Capper-Volstead Act ". . . cannot be deemed to authorize any combination or conspiracy with other persons in restraint of trade that these producers may see fit to devise" [14, p. 204–205].

The *Case-Swayne* decision raises a basic question as to the extent to which nonproducers can participate in the activities of a marketing cooperative and still maintain its exempt status. The court's decision provides some insight into this question, but leaves an important gray area. First, 5 percent of the Sunkist local association membership were corporate arranged, profit making, vertically integrated grower-packing houses. The court reasoned that since these organizations were owned by producers, they did not jeopardize the antitrust exempt status of Sunkist.

Does this mean that in order for a cooperative to maintain its antitrust exempt status, it must completely divorce itself of nonproducer interests? Apparently not. In its concluding statements, the court recognizes ". . . that producers who desire to organize for collective marketing might not have, at the outset, the necessary finances to do so, and might therefore seek capital from nonproducers. . ." [5, fn. 13, L. Ed. 2d, p. 628]. It notes, however, that the financial stake of such nonproducer participation does not directly enlarge the market share already possessed by the producers themselves. In contrast, the participation in Sunkist by nonproducer packing houses has precisely the effect of increasing the market share of Sunkist. Therefore, the most direct lesson from the *Case-Swayne* case is that *noncooperatives or nonproducer interests should not be used by marketing cooperatives as a method of increasing their market share.*[3]

A gray area which still exists after the *Sunkist* case involves the extent of nonproducer interests which can exist in a local association and yet maintain its exempt status. Would partial integration into orange growing by the nonproducer associations be sufficient to make them a producer within the meaning of the Capper-Volstead Act? The answer to this question is uncertain, but past antitrust decisions and the reasoning in the *Case-Swayne* decision suggest that the answer would depend largely upon the motive for integration. Given merely token integration, with nonproducers the main beneficiaries, the cooperative very likely would not maintain its exempt status. Thus, a livestock marketing cooperative probably would not be able to maintain exemption if a large meat packer involved in some cattle feeding became a local affiliate. In any event, it would appear that the decision severely limits cooperative use of nonproducer organizations as a means of obtaining more market control.

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[3] It should be noted that, except to the extent that the definition of a Capper-Volstead cooperative is affected by the *Case-Swayne* decision, there does not appear to be any effect on the procedures provided for under section 2 of the Capper-Volstead Act. Neither does the *Case-Swayne* decision affect the eligibility of an association to borrow from the Bank for Cooperatives, which requires that 90 per cent of the voting control of a borrower be in the hands of producers.

Another question that remains open after the *Sunkist* case is the extent to which a cooperative can control or increase its share of the market and yet not be held to have monopolized the market in violation of section 2 of the Sherman Act. As indicated previously, the court has held that while the Capper-Volstead Act gives cooperatives the right to organize and carry out its legitimate objectives, a cooperative may still be found liable under section 2 of the Sherman Act for wrongful use of monopoly power and attempt to monopolize [4, 5, 7, 9, 12, 14]. Therefore, in the case of a section 2 violation, the standard of legality would likely be the same as that applied to cases involving noncooperative firms charged with a combination or conspiracy to monopolize [4, p. 458; 9, 14].

Violation of section 2 involves both the structural elements of monopoly and the act of monopolizing. Thus in *U.S. v. Grinnell*, the court stated that "The offense of monopoly under section 2 of the Sherman Act has two elements: (1) the possession of monopoly power in the relevant market and (2) the willful acquisiton or maintenance of that power as distinguished from growth or development as a consequence of a superior product, business acumen, or historic accident" [16, p. 570].

The proportion of the market that a firm must control to be considered to have monopoly power is not clear cut. In *U.S. v. Alcoa*, the court stated that a firm's control of over 90 percent of the market is enough to constitute a monopoly. At the same time the court stated, ". . . it is doubtful whether sixty or sixty-four percent would be enough; and certainly 33 percent is not" [15, p. 424]. In the *Alcoa* case, the combination of over 90 percent control of the relevant market with evidence that Alcoa had diligently sought to accomplish and maintain this control, through means such as the maintenance of substantial excess capacity and similar exclusionary practices, led the court to the conclusion that Alcoa had monopolized the market in violation of section 2 of the Sherman Act.

In *U.S. v. United Shoe Machinery* [17], United's control of 75 percent of the shoe machinery market, combined with a network of long term leases that strengthened its power to exclude competitors, was in violation of section 2. Similarly, in the previously mentioned *Maryland-Virginia Milk Producers* case, 86 percent control of the milk supply, combined with agreements to exclude competition, was declared illegal. These and other cases led Earl Kintner, former general counsel to and thereafter chairman of the Federal Trade Commission, to conclude that ". . . if a corporation has the power to fix prices or to exclude competition in the market in which it competes, or if it dominates roughly 75 percent of the market in which it competes, there is a good chance that a court will hold that it possesses the requisite powers for monopolization" [8, p. 100]. The *Maryland-Virginia* case and the *Borden* case indicate that a cooperative which combines about 75 percent control of the market with the power to fix price or attempts to exclude competitors might well be subject to prosecution under section 2 of the Sherman Act, notwithstanding the fact that it is a Capper-Volstead cooperative.

A court of appeals decision that has received much attention from cooperatives and their leaders is *Cape Cod Food Products v. National Cranberry Assn.* [2]. In the *Cape Cod* decision, the court stated that a cooperative may attain a monopoly ". . . to the extent of 100 percent of the market through superior skill, efficiency, superiority of product . . ." or "if it does it exclusively through marketing agreements approved under the Capper-Volstead Act" [2]. This statement should not, however, be taken as a basis for cooperative monopoly activity. First, it is not completely consistent with statements in other Supreme Court and court of appeals decisions, some of which were discussed previously in this article [4, 5, 7, 9, 12, 14]. Second, in the next breath, the court repeated what it has stated in other cases: that "It would be a violation of the law, and it would be a prohibited monopolization for a person or group of persons to seek to secure a dominant share of the market through restraint of trade which was prohibited, or through a predatory practice or through the bad faith use of otherwise legitimate devices" [2]. Third, the court used similar language with respect to superiority, skill, and efficiency when Alcoa was found guilty of monopolizing activity [15]. Cooperatives must thus, under existing laws, be very careful when it comes to monopolizing activities. It should be apparent from this discussion that the law in the monopolization area with respect to cooperatives is unsettled.

Case-Swayne Co. v. Sunkist Growers, Inc. provides marketing cooperatives with a much needed guide regarding their membership. If an association has any nonproducer member who has any voice or vote in association affairs, the Capper-Volstead Act cannot be used as a defense in a restraint of trade charge based on section 1 of the Sherman Act. In addition, the Capper-Volstead exemption cannot be relied on to protect a cooperative from charges of monopolization under section 2 of the Sherman Act.

As bargaining and consolidation of cooperatives by merger and federation become more prevalent, the extent of exclusion from antitrust prosecution which is provided by the Capper-Volstead Act will become an increasingly important issue. Also, as agriculture becomes more fully integrated, the distinction made in the *Case-Swayne* decision between producers and producer interests will become an increasingly difficult question with respect to interpretation of the Capper-Volstead Act.

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PROCEEDINGS PAPERS

WINTER MEETING OF THE AMERICAN AGRICULTURAL ECONOMICS
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THE SUPPLY FUNCTION IN AGRICULTURE REVISITED
(Joint Session AEA and AAEA)

CHAIRMAN: GLENN L. JOHNSON, MICHIGAN STATE UNIVERSITY

Positivistic Measures of Aggregate Supply Elasticities: Some New Approaches*

LUTHER G. TWEETEN AND C. LEROY QUANCE

SUPPLY elasticities indicate the speed and magnitude of output adjustments in response to changes in product price. The elasticity parameter for aggregate farm output is especially important for public policy because it measures the ability of the farming industry to adjust production to changing economic conditions continually confronting it in a dynamic economy.

Farmers have considerable latitude to substitute one commodity for another in production over a long period. Eventually, this should lead to adjustments among commodities until comparable resources are earning similar rates of return in production of each commodity. Public policies concerned with the earnings of all farm resources and total farm income must consider the aggregate response of farm output to changing economic conditions. The aggregate response of output to price depends on total resource adjustments in agriculture. Because farm resources are adjusted much more easily among farm commodities than between farm and nonfarm commodities, it follows that the aggregate supply response, which tends to determine total resource earnings in agriculture, is less than the supply response for individual commodities.

Questions we attempt to answer in this paper include: What is the magnitude of the elasticity of U.S. farm output with respect to price in the long

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* Opinions expressed herein are solely those of the authors and do not necessarily represent official views of the U. S. Department of Agriculture

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and short run? Is the elasticity increasing over time as the ratio of purchased to non-purchased inputs increase? And are farmers less responsive to price decreases than to price increases as fixed asset theory implies? Three positivistic approaches are used to estimate the aggregate supply elasticity. The first is a direct least squares estimate of the aggregate supply function. One advantage of this approach is that it is straight forward and does not entail problems of aggregating estimated supply parameters with associated problems of substitution and interaction among the time series and difficulty in separating the influence on output of technology and durable resources—hence, it is difficult to determine the long-run supply elasticity.

Two additional disaggregate approaches which circumvent at least some problems of intercorrelation are also used to estimate the supply elasticity. One involves direct least squares estimates of the separate yield and basic production unit components of (a) crops and (b) livestock. These components are then aggregated to form the elasticity of total supply. The second disaggregate approach is to compute the elasticity of supply from production elasticities and demand elasticities for eight farm inputs. These latter two approaches add to our knowledge of component sources of aggregate supply response.

Direct Least Squares Estimates of the Aggregate Supply Function

Estimates of the aggregate U.S. supply function of farm products presented in Table 1 were obtained by regressing output on relative prices, productive assets, and technology as defined below:

O^t: The dependent variable, output, measured as the index of aggregate farm output (1957–59 = 100) [14]. In one equation, lagged output, O^{t-1}, is used as an independent variable.

$P_r/P_p{}^{t-1}$: The lagged index of the ratio of prices received by farmers for crops and livestock to prices paid by farmers for items used in production [3, 12]. When $P_r/P_p{}^{t-1}$ is for a specified period or for years of declining or increasing relative prices, it is the actual observation for the specified years but has a zero value for other years in the period observed (1957–59 = 100).

Sp^t: The beginning of the year stock of productive farm assets, including real estate, machinery, feed, livestock, and cash held for productive purposes; measured in millions of 1957–59 dollars [12, 13].

T: Productivity index; the ratio of farm output to all farm production inputs in the current year (1957–59 = 100) [12, 13]. This productivity variable reflects changes in management and technology as well as fluctuations in productivity induced by weather.

Table 1. Supply functions for aggregate farm output, *O*, estimated by least squares with annual U.S. data for specified time periods; coefficients, standard errors (in parentheses), and related statistics

Equation	Time period	R^2 d'[b]	Constant	P_r/P_p^{t-1}	S_p^t	T	O^{t-1}
1	1921–66[a]	0.993 .871	−30.70	0.0693 (.0194)	0.2167 (.0965)	1.0449 (.0559)	
2	1921–41	.890 .968	−69.23	.05326 (.0327)	.6366 (.4441)	1.1395 (.1007)	
3	1948–66	.982 .465	−57.23	.1380 (.0811)	.4901 (.2365)	.9587 (.0862)	
4	1921–66	.993 .932	−26.41	*1921–32* .0738 (.0179) *1933–47* .0628 (.0175) *1948–66* .0695 (.0165)	.0969 (.1158)	1.1134 (.0655)	
5 (Increasing prices)	1921–66	.992 1.1108	−45.54	.1066 (.0267)	.4264 (.1312)	.9425 (.0755)	
6 (Decreasing prices)	1921–66	.996 .962	−19.00	.0502 (.0173)	−.0002 (.0974)	1.1521 (.0561)	
7	1921–66	.993 1.442	−18.48	*Increasing prices* .0554 (.0154) *Decreasing prices* .0538 (.0163)		.9667 (.0642)	.1776 (.0563)

[a] Observations for the years 1942–47 are omitted.

[b] The Durbin-Watson autocorrelation statistic d'. The test for autocorrelation is inconclusive in equation 2, 5, and 7; and is significant at the .05 probability level (two-tailed) in the remaining equations. Computing a first order autoregressive scheme was precluded by lack of time.

Two approaches were used to test for differences in supply structure over time and between increasing and decreasing price phases. One was to estimate separate equations for component periods and use an F test to determine if the structure was unchanged. Another approach was to divide the price variable into component periods but leave other variables unchanged in the single least squares equation for the entire period.

In equation 1 (Table 1), output is expressed as a function of relative prices, the stock of productive assets, and productivity with observations over the

1921–1966 period, excluding 1942–47. The variables account for a high proportion of the variation in output and in all instances, the hypothesis that the respective coefficients are equal to zero is rejected at the 0.05 probability level.

The same specification is repeated in the next two equations with equation 2 estimated with 1921–41 data and equation 3 with 1948–66 data. Standard errors increase markedly compared with those in equation 1 and statistically, only the coefficients of T in the two equations are consistently different from zero. An F value, calculated to test the hypothesis that the respective coefficients in the two equations were equal, was nearly one. Hence, there is no basis to conclude that the structure of supply changed between the postwar and prewar periods.

The limited observations in the equations segmented by time periods poses a problem. To conserve degrees of freedom and to obtain a more precise test of possible changes in the response of output to price, equation 1 was reestimated with the price series divided into three segments. The first price variable contained actual observations for the 1921–32 period, zeros elsewhere. The second contained actual price observations for the 1933–47 period, zeros elsewhere. And the same procedure was used to construct a third variable for price in the 1948–66 period. The resulting specification in equation 4 explained no more of the variance than that in equation 1. The price coefficients were significantly different from zero at the 0.01 level, but a statistical test is hardly needed to conclude that the coefficients of the segmented price variables do not differ significantly. In short, there is little basis from equations 1–4 to conclude that the response of output to price has increased over time.

Equations 5, 6, and 7 are included to determine whether the supply structure differs between years of increasing and decreasing prices. The coefficients in equation 5, estimated with 23 observations from years of increasing prices in the 1921–66 period, are significantly different from zero at the 0.01 probability level. The coefficients of the price and productive assets variable in equation 6, estimated with 23 observations from the years of decreasing prices in the 1921–66 period are smaller in magnitude and statistical significance than their counterparts in equation 5. An F test was used to evaluate the hypothesis that the structure of supply was unchanged between increasing and decreasing price years. The hypothesis that the respective coefficients in the two equations were equal is rejected at the 0.10 level but not at the 0.05 probability level. Since the probability was small (less than 10 percent) of obtaining an F ratio so large if the structure was identical for increasing and decreasing prices, some support is provided for the role of fixed asset theory in explaining aggregate supply response.

Equation 7 expresses farm output as a function of productivity, lagged output, one price variable for decreasing prices and another price variable for increasing prices. Coefficients of all variables differ significantly from zero at the 0.01 probability level But coefficients of the segmented price variables are nearly identical, giving no basis for concluding that the response of farm output to price differs from rising and falling prices.

Several variants of the equations in Table 1 were estimated. One was to divide lagged output into segments and leave price and productivity in their original form for the 1921–66 period. Dividing lagged output into two variables associated respectively with increasing and decreasing prices permitted evaluating the hypothesis that the rate of adjustment of output to the two variables differed between price phases. Segmenting lagged output into three variables associated respectively with the 1921–32, 1933–47, and 1948–66 periods as with price in equation 4 provided a test of the hypothesis that the adjustment rates differed among these periods. Similarity of adjustment rates provided no support for either of the two hypotheses.

Most equations in Table 1 were also estimated with data coded into logarithms. The R^2's of the logarithm equations were generally below those for the equations in Table 1. Also, the equations estimated in logarithms provided no support for the hypothesis that the elasticity of supply is increasing over time or that the elasticity of supply is greater for increasing prices than for decreasing prices.

Elasticity of supply

We now examine supply elasticities estimated from equations in Table 1. The rising proportion of farm inputs comprised of highly productive and flexible purchased inputs including fertilizers, pesticides, and improved feed supplements suggests that the supply elasticity rises over time. On the other hand, farming is becoming more specialized. If an increasing proportion of farm output is produced by highly specialized broiler, pork, beef, or feed producers who continue to operate at full capacity over a considerable range of price ratios, supply elasticity will fall. Furthermore, the elasticity of supply $(\partial O/\partial P)\ (P/O)$ may fall because the marginal coefficient $\partial O/\partial P$ derived from equations such as those in Table 1, even if increasing over time, is more than offset by a falling P/O ratio. The ratio P/O has in fact fallen as output expanded and prices declined. This is expected with improved resource productivity—more is produced at a given price while maintaining the rate of return on resources.

Prices also influence output in the short run through the stock of productive assets, Sp, and this impact is accounted for in the Table 2 estimates.[1]

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[1] The stock of production assets was regressed in linear form on time, $P_r/P_p{}^{t-1}$, and lagged production assets with the following results:

$$(6.)\quad S_p{}^t = \underset{}{0.73} + \underset{(0.025)}{0.072}\ (\text{Time}) + \underset{(0.009)}{0.020}\ (P_r/P_p)^{t-1} + \underset{(0.036)}{0.935}\ (S_p{}^{t-1})$$

with $R^2 = 0.990$. Standard errors are in parentheses. From this equation, the elasticity of $S_p{}^t$ with respect to $P_r/P_p{}^{t-1}$, E_{sp}, was 0.228 for 1921–66; 0.598 for 1921–41; and 0.481 for 1948–66.

The 0.155 supply elasticity computed from equation 1 is the best single estimate of the short-run supply elasticity for the entire period. The results provide no clear mandate for a higher elasticity in the postwar period nor in increasing price phases; hence, 0.155 may be the best estimate for any of these conditions. Nevertheless, supply elasticities are also shown for increasing and decreasing prices and for the postwar and prewar periods. Equations 5 and 6 indicate that the short-run supply elasticity could be 0.17 for price increases and 0.07 for price decreases. Estimates from equations 2 and 3 indicate that the short-run elasticity could be 0.08 in the prewar period and 0.16 in the postwar period. But elasticities computed from equation 1 contradicted this conclusion in that a declining P/O ratio is multiplied by a fixed marginal coefficient 0.0693. Additional evidence from other techniques are examined before a final interpretation is made of the short-run supply elasticity.

Table 2. Estimates of aggregate short-run supply elasticity of U.S. farm output for specified periods[a]

Period	Aggregate supply elasticity (Short run)
1921–1966	
Without regard to direction of price movement (Equation 1)	0.155
Price increases (Equation 5)	.169
Price decreases (Equation 6)	.069
1921–1941	
(Equation 1)	.132
(Equation 2)	.080
1948-1966	
(Equation 1)	.085
(Equation 3)	.162

[a] Elasticities computed from equations in Table 1 at the means of the respective periods, as indicated.

One hypothesis is that the equations in Table 1 fail to provide strong support for rising elasticities over time because the decreasing prices and attendant low elasticities occurred in the postwar period. Although concentration of decreasing or increasing prices in one of the segmented time periods could cause confounding of the two major hypotheses tested—that is not

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And the adjustment coefficient for productive assets g_{sp} is $1-0.935=0.065$. In adjusting the aggregate supply elasticity for the impact of P_r/P_p on S_p, the short-run elasticity is equal to the elasticity of supply with respect to price derived from equations in table 1 plus the elasticity of output with respect to productive assets derived from equations in table 1 multiplied by the elasticity of productive assets with respect to P_r/P_p, E_{sp}. The long-run aggregate supply elasticity is obtained in a similar manner except that the elasticity of productive assets with respect to P_r/P_p is divided by the adjustment coefficient for productive assets, g_{sp}, in the above calculations.

the case in Table 1. Excluding 1942–47, of the 19 years of increasing prices in the 1921–66 period, 11 occurred in the 1921–41 period and 8 in the 1948–66 period. And of the 21 decreasing prices, 10 occurred in the 1921–41 period and 11 in the 1948–66 period.

The long-run supply elasticity from all equations except 7 in Table 1 can be computed by considering the long-run impact of prices on *Sp* and *T*. Productivity, *T*, regressed on prices and a time variable revealed no association between prices and *T*. Thus, the impact of prices on output through *T* can be ignored. The influence of prices on output through *Sp* is found from a regression of *Sp* on prices and other variables as indicated previously in footnote 1. The long-run supply elasticity is estimated at 0.31 both for the 1921–41 (equation 2) and for the 1948–66 (equation 3) periods. Equation 1 indicates a 0.19 long-run supply elasticity for the 1921–66 period. The long-run elasticity computed from equation 7 is also in line with this estimate. These estimates are considerably below the 0.6 long-run supply elasticity estimated by Heady and Tweeten in 1963 [5, p. 435]. The long-run supply elasticities computed from the equations in Table 1 are also low when compared with results from the disaggregate approach presented later. We conclude that high correlation between productive assets, *Sp*, productivity, *T*, and, in the case of equation 7, lagged output, biases the long-run supply elasticity toward zero.

Aggregate Supply Elasticity Computed From Crop and Livestock Components

Estimates in Table 3 of the elasticity of crop acreage, yield, and other components of aggregate supply with respect to price are taken from previous studies. In these studies, the coefficients of livestock and crop supply functions were computed by least squares from time series. The components are weighted and combined to form an estimate of the elasticity of aggregate supply. The underlying data were not adequate for separating the elasticities for increasing and decreasing prices and for postwar and prewar periods.

For all crops, the acreage response to price is quite low in both the short and long run (Table 3). But yield response is considerable in the long run. The total elasticity of farm crop production with respect to prices received by farmers is the acreage elasticity plus the yield elasticity corrected for the negative effect of higher acreage on yields as production moves to lower yielding land.

The production period for livestock such as poultry and hogs is comparatively short, hence, animal units of livestock show a greater response than acreage to higher farm prices (Table 3). While output per animal unit is more responsive to price than is the number of animal units in the short run, the reverse is true in the long run. That is, there is greater potential for expanding livestock production by increasing the number of animal units than by

Table 3. **Estimated aggregate supply elasticity of farm output, with crop and livestock components**[a]

Item	Elasticities	
	Short run (2 years)	Long run (Many years)
Crops[b]	0.17	1.56
Acreage	.04	.10
Yield per acre	.15	1.50
Livestock[c]	.38	2.90
Animal units (stock)	.12	1.80
Yield per animal unit	.26	1.10
Aggregate supply elasticity[d]	.25	1.79

[a] Data interpreted from [1; 5, Ch. 16].

[b] The elasticity of crop production C with respect to farm price P is E_{CP}. Given the elasticity of acreage with respect to price E_{AP}, the elasticity of yield with respect to price E_{YP}, and the elasticity of yield with respect to acreage $E_{YA} = -.4$, then $E_{CP} = E_{YP} + E_{AP}(1 + E_{YA})$.

[c] Computed as in above footnote, with the elasticity of livestock yield with respect to animal units E_{YA} equal to zero.

[d] Computed by the formula: $E_{OP} = E_{CP}\ C/O + E_{LP}\ L/O + E_{LC}\ E_{CP}\ L/O$ where O is total farm output, C is crop output, L is livestock output, and P is the index of prices received by farmers. E_{OP} is the supply elasticity of O with respect to P. Other elasticities E_{ij} are interpreted accordingly. E_{LC} is assumed to be -0.4 in the short run and -0.6 in the long run.

increasing yield per animal unit over an extended period. Empirical results do not show that increasing the number of animal units depresses the yield per unit; hence, the supply elasticity of total livestock output is the simple sum of the unit and yield components.

The total elasticity of farm output with respect to product price is a weighted sum of the livestock and crop components. There are opportunities to substitute livestock for crops by feeding. We attempt to include this interaction by a term E_{LC} which is the elasticity of livestock output with respect to crop output (see footnote d, Table 3). With a given supply of crops, an increase of livestock means less crops for final sales to consumers—hence, E_{LC} is negative. The elasticity of total supply computed from data in Table 3 is 0.25 in approximately 2 years and is 1.79 in many years. This implies that a sustained 10-percent increase in prices received by farmers raises farm output 2.5 percent in 2 years and 17.9 percent in many years. The reliability of some of the estimates such as E_{LC} in Table 3 is low, and the elasticities must accordingly be interpreted with caution.

Aggregate Elasticity of Supply Computed from Farm Input Components

Agricultural economists place much emphasis on factor markets as the roots of the supply adjustment problem in agriculture (see, for example, Hathaway [4], Heady and Tweeten [5], and Glenn Johnson [7]). And in stratifying capital inputs into groups with similar characteristics with respect to durability, degree of specialization, and source of supply, Quance found that expendables are adjusted toward rates of use which equate relevant *ex post* MVPs or lifetime earnings with original acquisition costs more rapidly than durables, farm-produced durables more rapidly than nonfarm-produced durables, nonfarm-produced expendables more rapidly than farm-produced expendables, and inputs which are unspecialized to the farm sector more rapidly than specialized inputs [8]. These differing adjustment rates for farm inputs have important implications for aggregate supply elasticity. Before drawing conclusions concerning the magnitude of aggregate supply elasticity, a further estimate relating the elasticity of supply to the adjustment of specified input categories is obtained.

This estimate of supply elasticity is determined from the elasticities of production and the elasticities of input demand with respect to prices received by farmers. In other words, output is a function of the productivity of an input and its level of use. And the level of use is a function of farm product prices.

From the estimates of production elasticities and elasticities of demand for specified inputs in Table 4, the contribution of an input i to aggregate supply elasticity is obtained by multiplying the elasticity of production, E_{Oi}, by the elasticity of demand, E_{ip}, for input i. The total price elasticity of supply of farm output E_{CP} is then

Table 4. Estimated elasticities of production, input demand, and product supply for U.S. agriculture[a]

Input	Elasticity of production	Elasticity of demand				Contribution to aggregate supply elasticity	
		Own-price		Product price			
		SR[b]	LR[b]	SR	LR	SR	LR
Fertilizer and lime	0.06	−0.6	−1.8	0.5	2.4	0.030	0.144
Machinery operating expenses	.11	−1.0	−1.5	.5	2.5	.055	.275
Feed, seed, and livestock	.09	− .8	−1.5	.7	2.0	.063	.180
Miscellaneous current operating expenses	.09	− .3	− .5	.3	2.5	.027	.225
Crop and livestock inventories	.04	− .2	−1.0	.2	2.5	.008	.100
Machinery inventory	.10	− .2	−1.0	.2	2.6	.020	.260
Labor	.25	− .1	− .5	.1	1.0	.025	.250
Real estate	.28	[c]	[c]	.1	.3	.028	.084
Total elasticity	1.02					0.256	1.518

[a] Data based on [5], [9], [10], and [11].

[b] SR refers to a short run of 2 years; LR refers to a long run of many years.

[c] Nearly zero.

Based on these estimates, a once-for-all *decrease* of 10 percent in prices received by farmers would decrease output 1 percent in 2 years and 8 percent after many years. But a once-for-all *increase* of 10 percent in prices received by farmers would increase farm output 1.5 percent in 2 years and 15 percent after many years. The relative difference is less between the short-run elasticities for the two price phases than between the long-run elasticities. This is because the operating inputs which generate the shortrun response are consumed with little carryover of service—hence, give rise to little resource fixity and to greater symmetry in response to price. The long-run elasticity, which depends on durable inputs, is more heavily influenced by resource fixity and this is reflected in the considerable differences in long-run elasticities for increasing and decreasing prices.

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The Representative Farm Approach to Estimation of Supply Response

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IN this paper I discuss the role that representative farms have played in the estimation of *aggregate* supply response, and I speculate on the future role of representative farms in *aggregate* analyses. I do not discuss the valuable contribution or the problems associated with the use of representative farms in *firm* analyses *per se.*

Many empirical techniques can be used to estimate aggregate supply response. They include regression, spatial equilibrium, mathematical programming, and less formal techniques. However, the representative farm approach has been by far the most popular research approach used for both firm and aggregate supply response analysis during the 1960's. True, other techniques were used, but no model in the history of production economics has received as much widespread research support in the form of research funds and professional manpower. I am referring to the regional adjustment studies and the associated state studies. In all these studies representative farms were used to estimate aggregate supply response. Since most of the regional adjustment studies have been completed, it is time to evaluate how well this approach to supply response has worked, and to speculate about where we should go from here in aggregate supply analysis.

Representative Farms and Aggregate Supply Response—Last Ten Years

The history of supply response research and the role played by representative farms are well documented.[1] I would like to break into the historical chain of events at about the late 1950's. At that time there was discussion about a supply response model that was based on the aggregation of representative farm results—the model that later became the foundation of the regional adjustment study research. This model had five major components. These were, following Barker and Stanton [1, p. 701]: (1) stratify all farms within a region into homogeneous groups, (2) define a representative farm for each stratum, (3) derive supply functions for each farm, (4) aggregate the supply functions, and (5) remove the model's simplifying assumptions and adjust the results accordingly in order to make predictions or prescriptions. I can find no label in the literature for

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[1] See Barker and Stanton [1], Nerlove and Bachman [7], the book on agricultural supply functions edited by Heady and others [6], and the proceedings papers and discussions of the use of representative farms in agricultural economics, at the summer, 1963, AFEA meetings [3], [5], [9].

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this model so I will call it a "representative farm aggregation" model (RFA model).[2]

The RFA model had an intuitive appeal. First, it seemed to provide the missing research link between the firm and the industry—the micro and the aggregate. The impact of a change in a variable could be traced from the farm where the production decisions are made, up to the industry where policy decisions are made. A model that could predict aggregate response via the micro route appeared to be a powerful tool.

Second, the normative characteristics of the RFA model would allow its use for studying conditions that had not occurred in the past. This model could overcome the great limitation of regression analysis.

The RFA model was not new in the late 1950's, but two research innovations caused renewed interest in the model—linear programming and electronic computers. It would have been a formidable task to derive supply functions for many representative farms by hand, using conventional budgeting techniques. But LP and computers overcame this problem. Thus, the profession got excited about the potential of the RFA model as a research tool. It appeared that even though many theoretical and technical problems were anticipated, we were surely at the dawn of a new era in understanding aggregate supply response.

In 1958 the first of six regional adjustment studies—the Lake States dairy study—was initiated. Over the next five years similar adjustment studies were started in the Northeast, South, Corn Belt, Great Plains, and West. The RFA model was the foundation for each of the six regional studies. The Lake States dairy study was completed in 1963.[3] The last of the regional adjustment studies will probably be completed by 1969.

These studies were cooperative ventures by the State agricultural experiment stations and the Farm Production Economics Division of the Economic Research Service, U.S. Department of Agriculture. The primary objectives of all the regional adjustment studies were (1) to estimate adjustments needed in resource allocation on farms to maximize profits, (2) to estimate regional supply response, and (3) to determine an equilibrium supply-demand condition for a region and then for individual farms. The U.S. Department of Agriculture had special interest in short and intermediate-run regional analyses and the State experiment stations had special interest in the farm, sub-State and State analyses.

The great expectations that the profession had for the RFA model as used in the regional adjustment studies is shown by the large expenditure of research resources we were willing to invest. A rough measure of this research support is the number of published reports and the number of M.S. and Ph.D. theses connected to the regional adjustment studies. For example, from the Southern (S-42) and Corn Belt (NC-54) adjustment studies combined came over 80 research publications, 40 M.S. theses, and 20 Ph.D. theses. Many of the theses are included in the count of publications. Additional publications and theses came—and are still coming—from the other adjustment studies but a tally of them is not available. The profession will, for many years, be feeling the impact of having a large number of their production economists trained via the regional adjustment studies.

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[2] I use "RFA model" to refer to a model where (a) the unit of analysis is obviously the firm; i.e., the restrictions and alternative activities in the model reflect a firm's restrictions and alternatives, and (b) the primary objective is the estimation of aggregate supply response.

[3] The Lake States results are summarized in [12]. Examples of other regional results are [4], [8], and [10].

Much has been gained from the regional adjustment studies. First, but possibly not foremost, were the representative farm adjustment results and the regional results. Second, a data base (budgets, representative farm data, and other quantitive data) was established that is currently being utilized and updated in other research projects. Third, these studies provided graduate training, as noted above, and technical training as well. Many in the profession got their first taste of mathematical programming and electronic data processing via the regional adjustment studies.

And fourth, we learned that the problems connected with the RFA model were more devastating than we had first imagined. The aggregate regional analysis—the justification for having regional projects—was disappointing. I think that the disappointment, however, was caused more by the original great expectations than by actual performance.

Problems with the RFA model

Several writers have dwelled on the problems associated with the RFA model as used in the regional adjustment studies.[4] The problems most difficult to overcome can be grouped into five categories: (1) interdependence or externalities, (2) change in farm size, (3) unrealistic firm-level assumptions, (4) the selection of representative farms, and (5) mechanical problems.

Interdependence or externalities.—In the RFA model used in the regional adjustment studies, aggregate supply response is obtained by the summation of weighted representative farm supply functions. The individual farm's input costs and physical transformation rates are assumed to remain constant at all levels of aggregate production. But we know that the aggregate level of production has a major impact on input prices which in turn affects each farm's supply function. The impact is greater as larger regions are analyzed. If we were studying supply response of corn and our analysis were limited to Michigan, a 20-percent change in corn production in Michigan would not have a major impact on input prices, but if the Corn Belt were our area of analysis, a change in corn production of 20-percent would alter input prices considerably.

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[4] For example, see Barker and Stanton [1], Sharples, Miller, and Day [11], or Brokken [2].

Attempts are now being made to overcome this problem by putting all representative farms into one programming model. The major inputs can then be limited on a regional or sub-regional level, or they can enter the matrix as a regional stepped supply function. The representative farms could then compete for inputs such as beef feeders, feed, and labor. However, this approach creates about as many problems as it solves. How do you define the regional or sub-regional supply of, say, beef feeders? Are you willing to live with a solution that maximizes area profits instead of firm profits? Also, the size of the computational problem becomes a major factor in limiting the number of representative farms.

Change in farm size.—A major factor associated with aggregate supply response is the changing size of the farm. In the RFA model it is very difficult to evaluate the aggregate impact of allowing representative farms to buy or rent additional land. There is no way to insure that purchased land equals sold land or that land rented in equals land rented out. In an attempt at overcoming this problem, several studies projected the distribution of farms by size to the target date of the study. The representative farms could then be aggregated using projected aggregation coefficients. But these attempts do not show which farms would change size or how the purchase or rental of additional land would compete with alternative farm uses of capital.

Unrealistic firm-level assumptions.—Many of the assumptions of the RFA model can be grouped under this problem heading. These include: Farmers are profit maximizers, farmers have no enterprise preferences, farmers have perfect knowledge of their alternatives, uncertainty does not enter into the choice criteria, and so on. These assumptions pertain to the individual representative farms but they have profound aggregate implications. Alternative assumptions could be examined. For example, a model that minimizes the cost of obtaining an income goal may be appropriate. Or it could be assumed that only those enterprises currently on a farm would be included in the model; i.e., livestock enterprises would not be alternatives on a representative cash grain farm.

Selection of representative farms.—The selection of representative farms and the associated problem of aggregation error have probably been the subject of the most thorough and diligent research of any of the problems listed above. These studies have shown that the number of representative farms needed to eliminate aggregation error approximates a geometric function of the complexity of the model. As more restraints and activities are defined, many more representative farms are needed. Thus one can only strive to minimize aggregation error—not eliminate it.

These studies have also shown that the traditional methods of stratifying farms—by farm size, soil type, or farm type—may lead to a set of representative farms all of which have about the same optimum organization. Recognition of differences in institutional restrictions, motivations, preferences, ability, and other human factors need to be built into the specification and stratification schemes.

Mechanical problems.—A few words need to be addressed to the purely mechanical problems associated with a model that is used to estimate aggregate supply response by summing representative farm supply functions. Only a dedicated Ph.D. candidate would have the incentive to assemble all the budgets and restraints necessary to build a reasonably rigorous model. And once the budgets and restraints are defined, the matrices are complete, and the computing is underway, a second mechanical problem arises: How will one analyze all the computer output. It takes great skill to keep from being buried in computer print-out. These technical problems cause a researcher to think twice about making any improvements in the RFA type of model that would lead to more representative farms or more activities and restrictions. Also, as one tries to build more realism into the model, he risks making the model so complicated that he cannot readily trace the logical connectives between a change in an instrument variable and a resulting change in production. A model's results are of little value if they are not accompanied by a statement explaining the causes of changes.

Future Role of Representative Farms in Aggregate Supply Response Research

This brings us up to date. We know that the RFA model as used in the regional adjustment studies has serious limitations—as do all models—and that currently there is some research endeavor to better understand the limitations. But where do we go from here in aggregate supply response analysis? What role should representative farms play in future supply response research? In order to address these questions, we need to differentiate between short-run and long-run supply response.

I do not expect the RFA model to contribute much more to expanding our knowledge of intermediate and long-run aggregate supply response. Two considerations led me to this conclusion. First, the coefficients in the RFA model reflect an assumed level of technology, an assumed institutional structure, and an assumed size of farm. Given these assumptions the RFA model focuses on profit maximization. This model has empirical relevance. But the most dynamic ingredient affecting supply response is the changing structure of agriculture—changing technology and the changing institutional framework within which agriculture functions. Representative farm models look at only one point in the whole spectrum of structural change. A more appropriate model would be one that focuses more on structural changes and less on profit maximization and movements toward equilibrium.

Second, the representative farm becomes much more difficult to define as economic time (and calendar time) becomes longer. Production coefficients, resource ratios, the objective function, and other farm characteristics are usually based on existing farms. Adjustments can be made in the parameters for some assumed increase in efficiency. But the present structure of agriculture pervades the data. When current data are used for describing a representative farm, a structure is assumed for the credit market, the input markets, the product market, Government policy, and so on. If one were to define representative farms for some point in future time, he would have to speculate on the whole structure of agriculture at that point in time before he could develop his coefficients. Because of the dynamics of agriculture, the longer the economic time period, the harder it is to specify characteristics of individual farms.

I must admit that I have no better model to put forth. Besides, that is outside the realm of my assigned topic. However, I think that we should put relatively more effort into intermediate- and long-run aggregate supply response research using aggregate data and aggregate relationships.

A conditionally normative representative farm approach to aggregate supply response is still intuitively appealing for certain types of short-run questions. For example, we may wish to analyze a 1-year response of farmers to a change in Government policy relating to diversion of wheat allotment acres. What aggregate changes would take place in wheat production, production of other crops, resource use, and farm income? In order to answer these questions adequately one must look at aggregate data and aggregate relationships, but one can get valuable insights into the nature and magnitude of the aggregate relationships by examining the effect of the policy change on several well chosen representative farms. Also in the short run (both in terms of short-run economic time and in terms of 1–3 years calendar time) technological and institutional change are much more predictable than in the longer run. Thus, the representative farm identification problem is less difficult to handle than in the long-run analysis. We can estimate production coefficients, resource ratios, and how many farms there are with various characteristics assuming the current structure of agriculture.

Up to now there has been virtually no use of representative farms for analyzing short-run aggregate supply response. The reasons are twofold: (1) the primary objective of State or regional supply response studies has been to analyze State or regional adjustment implied under normative equilibrium conditions. This objective necessarily implied a longer run model; and (2) it took a long time to collect data, define representative farms, compute, aggregate, and analyze the results. There was always the fear of finishing the study after the study projection period had passed. So projection dates had to be at least 5 years beyond the starting date of the study, or one might end up projecting to a time period that had already passed.

In order to use representative farms as an aid in short-run aggregate supply analysis, we will need to change our concepts of the role of representative farms in aggregate analyses. First, new ways will need to be developed for linking firm response to aggregate response. A simple horizontal summation of weighted representative farm supply functions has not proven satisfactory. Second, the model will have to be simpler—not more complex—than we envisioned in the past. Data handling, computing, and analysis of results will have to be streamlined, so that the research can be done quickly. For short-run analyses, timeliness of results is vital. In order to be timely, the model must contain relatively few representative farms—more in the nature of five to ten than 100-400 as in the regional adjustment studies. Experience with the adjustment studies showed that the major economic relationships—those relationships that the researchers were trying to isolate—did not differ greatly over the 100–400 representative farms. Most of these relationships could have been isolated by some parametric resource and price programming on fewer representative farms.

As an example of how this model might work, consider the following: Suppose we wanted to analyze how an increase in price support rates in a Government feed grain program would affect Iowa farmers. In order to adequately answer this question we would need to estimate changes in production, resource use and income at the State level and also give some description of which farmers would be affected. There are considerable data available at the State level to give a rough indication of the magnitude of change. Historical data series at the State level could give some indication of farmers' willingness to adjust their cropping patterns in the past to changes in instrument variables. Several representative farms in Iowa could also be analyzed to see how increased corn price supports would affect optimum production, resource allocation and income at the firm level. Information gained at the firm level could be used as an aid in adjusting the aggregate estimates.

I am admittedly vague and sketchy about the linkage between the micro case-farm type of analysis and the aggregate analysis. All I wish to point out is that one can gain insights from a limited firm analysis that is useful for understanding short-run supply response at the aggregate level. We need not ignore this micro information just because it cannot be plugged into a neat mathematical aggregation formula. This type of short-run analysis is currently being tested by the Aggregate Production Analysis Team in the Farm Production Economics Division of ERS.

Conclusions

Barker and Stanton observed in 1965 that ". . . we are still a long way from developing usable estimates of national or regional supply from individual farm data. Is it realistic to hope to use individual farm data in estimating agricultural supply? In the mid-60's the answers are not yet clear. . . . The logic of building from the bottom up still seems to outweigh all the practical problems of data collection, programming and aggregation" [1, p. 712].

Over 3 years have passed since this observation was made. Much research has gone into the "practical problems." Now we better understand these problems but they are no less formidable. The evidence is mounting that the RFA model may not play a major role in future research of intermediate and long-run aggregate supply response. The RFA model did not turn out to provide the big research breakthrough that we had originally hoped.

The representative farm can play a potentially important role in short-run aggregate supply response. Knowledge of the potential economic impact of a change in an instrument variable on a farmer's income and organization is very valuable. However, the linkage between the firm and the aggregate may by necessity be an informal one.

Nerlove and Bachman in 1960 concluded their review of supply response research with the observation that "there is a need for a combination of empirical approaches to the supply problem at all levels of aggregation between firm and industry" [7, p. 533]. During the 1960's we have been preoccupied with one empirical approach—the RFA model. Supply response is better understood by more professionals because of the extensive use of the RFA model. But the profession paid a high price by not having a more diversified approach to supply response research.

A shift in emphasis is overdue. In terms of better understanding and more accurately quantifying aggregate supply response, I think the payoff will be small from future use of the RFA model. We do not need another round of regional adjustment studies using the RFA model. What we do need is to further explore less cumbersome models that identify and better utilize stable aggregate relationships. We also need to further explore the heart of intermediate and long-run aggregate supply response—technological and institutional change.

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Discussion: The Supply Function in Agriculture Revisited

JAMES H. WHITE

I will comment briefly on the Quance-Tweeten and Sharples papers and then consider some concepts of agricultural supply and problems involved in estimating supply functions for agricultural products. Some of my remarks will be directed toward the degree to which we have been conscious of these problems and to possible reasons for not taking them into consideration in the analytical models employed in studies relating to agricultural supply. We should be cautious of making final judgments on the ultimate value of our research efforts in estimating agricultural output. Agriculture is a dynamic industry and to determine exactly what it will look like at any point in the future is not possible.

The stated objective of the Quance-Tweeten paper was to develop posi-

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tivistic measures of aggregate agricultural output elasticities. They visualized that knowledge of the aggregate output response to changes in economic conditions would be helpful to those responsible for . . . "Public policies concerned with the earnings of all farm products and total farm income . . ." Estimates of the aggregate supply function and associated elasticities were made, using three approaches: (1) direct least squares, (2) separate yields and production unit components for crops and livestock, and (3) separate input contributions to total agricultural output. There was a tone of disappointment by the authors in the results of their analysis. They stated that it is difficult to give a precise answer to a policy maker who wishes to know the response of output to price but made concluding statements based on their judgement of the reliability of the data and the methodology. This is not necessarily bad. The position in which most of us find ourselves after any research effort is something short of complete knowledge of all the relevant variables and how they relate to each other and to the problem under consideration. A student of mine once remarked that if we publish only that which is statistically significant at the three or five percent level of probability, we would have a small printing bill.

Although estimates of aggregate agricultural output elasticities may be useful for some purposes, they are "too aggregate" for making inferences to lower levels of aggregation. It is not possible to separate the impact of price changes by regions, by type of farm, by commodity or by the magnitude of the various inputs used in production. However, the results obtained by Quance and Tweeten possibly could be made more useful by including in the paper more interpretation of the results as they indicated the need for doing.

Sharples, as well as others [1], has done an excellent job in discussing the role representative farms have played in estimating aggregate supply response. Nothing is to be gained by heaping criticism on the approaches that have been taken in supply studies. Virtually all of the problems encountered have long been recognized and were re-emphasized by Plaxico and others [2] before most of the recent supply studies were initiated. Possibly too much was expected of the models we were using and too little effort was made in developing meaningful coefficients.

The prime reasons we committed ourselves to the representative firm approach for studying aggregate supply and/or output response in agriculture were because Alfred Marshall legitimized the approach and it has been paramount in the training of most agricultural economists. I am of the opinion that the inclination for economists to continue using this approach has its genesis in their formal training where emphasis was placed on profit motivated static economic theory of the firm and its linkage to the industry. Then too, the tools at our disposal—linear programming, spatial equilibrium analysis, regression and others—were thought to be potent tools for quantifying input-output relationships of the firm. Had we taken a course that would have led to relating the motives of managers, their age distribution, their equity position and other less quantifiable subjective aspects of the firm and firm-household relationships of the farm to output response, we would have been banished from the profession. As viewed by some, the results from such an approach probably would have been no more useful than the results obtained by the representative farm approach. In view of the above it should come as no surprise to anyone that agricultural economists took the representative farm approach to the study of aggregate supply.

The many facets of supply may be the source of some of the difficulty and confusion economists have encountered in estimating supply and using supply estimates foreign to the purpose for which they were developed. Evidenced by the two papers presented here today, estimates of agricultural supply can relate to estimating the response of total agricultural output of a nation, or to the response in output of a single product for a given producing unit to changes in product prices. Supply studies can also relate to the classical supply relation that refers to how the quantity offered for sale varies as its price varies relative to other product prices for some given time period and level of technology. Estimates of supply may refer to what Cochrane [3] calls an output response relation describing what will happen to the commodity offered for sale when the time period and technology are not held constant. Supply estimates can relate to static or dynamic situations; short-, intermediate- or long-run time periods; commodity or aggregate agricultural output; national policy formulation or guidance to farmers; single- or multi-product firms; a farm or a region; and others. A step toward avoiding some of the difficulties we have encountered in supply studies is to explicitly specify the purpose for which the supply estimates are made, the assumptions, the source and reliability of the data, and methodology compatible with the data and the objectives of the study.

Effort is likely to continue in estimating the short- and intermediate-output response of firms to changes in physical, economic and institutional conditions. The exact methodology that will prevail is not clear. There are some who are yet to be convinced that the potential of the representative farm approach has been fully exploited. Regardless of the approach, the ultimate test will be the usefulness of the results. In all probability the reward from these efforts will be in proportion to the effort made in problem identification and specification, the development and refinement of technical coefficients and other relevant data, and the choice of model(s). Attention must be directed toward these things if we hope to duplicate reality—become more predictive—with estimates of how the output from agricultural firms changes in response to changing conditions.

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Discussion: The Supply Function in Agriculture Revisited

MARVIN KOTTKE

Sharples took us on a tour of the RFA model, and I want to commend him on the way he conducted the tour. However, after giving us a critical view of the RFA model, he suggested we take the long-run road on our next excursion. As one interested in taking the next excursion, I take issue with his suggestion because I see the long-run supply model as a dead-end road.

In laying the groundwork for my argument, I shall first talk about linkages. In the past decade, as pointed out by Sharples, considerable effort was devoted to finding a linkage between micro and macro supply response by use of the RFA model. The Tweeten-Quance model does not seek a micro-macro linkage but it starts at the opposite pole and attempts to disaggregate the macro in the direction toward micro units. I would submit, however, that the micro-macro linkage is only one of several that need closer attention if we are to make further advances in supply research. Time and spatial linkages are two more that are extremely relevant in contemporary supply behavior. They are especially so because of the current interest in building models for realistic application. In reality, the whole supply problem is intricately interwoven with time, spatial and micro-macro linkages. Our job is to find the best way to slice the problem into manageable relations and still capture the linkage effect.

It is clear that we have been less than successful in finding reasonable micro-macro linkages. But it may be of some comfort to know that we are not alone in the search. A year ago, at our Association's meeting [1], a

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session was held on micro-macro linkages in planning a rural economy. The linkage seemed to be elusive in that session also. Even its usefulness was doubted. In contrast, the linkage in supply response would not only be useful, but necessary. In supply analysis, the micro-macro linkage is primarily a feedback effect. We need to capture not only the individual firm's response, but also the feedback to the firms of the effect of their combined responses. It seems to me that a model incorporating cobweb and recursive relations could accomplish this type of micro-macro linkage.

The search for a spatial linkage has been more successful. Spatial linkages can now be handled with quadratic programming models for perfectly competitive industries. We still need to explore ways of introducing imperfectly competitive conditions. In the Northeast dairy adjustment project, we have made a preliminary test of a spatial model incorporating imperfect competition and institutional conditions and the results are promising. In using quadratic programming we have learned that the reasonableness of intercept parameters—their magnitude and their change through time—are just as crucial as elasticities. Hall, *et al.* [2], made the same observation in their application of quadratic programming. As a consequence, I expect that, in the future, we will be putting more effort into testing the reasonableness of the intercept parameters than in estimating elasticities.

Our attempts at handling time linkages in supply response have been rather vague in the past. Usually we have specified a length-of-run for the time dimension. But lengths-of-run, especially intermediate and long-run, are incapable of handling time linkages for the following reasons:

First, in reality, there is no single length-of-run that would represent all firms' supply behavior at a given point or period in calendar time. One of the shortcomings of the RFA model was that all farms were assumed to respond to price in unison during a particular calendar period of time. If one abstracts from calendar time, it is conceptually logical to assume that all firms could respond in unison and make the same length-of-run decision. But, if one dates supply response with calendar time, it is not logical to assume that all firms respond in unison and in the same direction. At any given calendar point in time some farmers may respond positively, others respond inversely, and still others do not respond at all. The differences in each firm's supply behavior are related to structural differences among farms, including such things as rate of technological adoption, capital position, and stage of life.

Second, the theoretical basis of the long-run supply model, particularly in the normative approach, has its roots in the Neo-classical cost curve analysis. Viner's abstract, long-run supply curves which explain increasing, decreasing, or constant cost industries, are quite inept for dealing with supply response in the 1960's. A clue to the long-run supply model's inappropriateness for today's agriculture can be detected in Viner's [3, p. 29] definition of long run, ". . . a sort of 'timeless' long run throughout which nothing new happens except the full mutual adjustment to each other of the primary factors existing at the beginning of the long-run period." This definition clearly rules out technological, institutional and price changes through time. By definition, then, it cannot deal with the major variables in agricultural adjustment, namely, technological change and capital investment.

Third, use of a long-run supply model introduces a semantics problem. Long-run supply has different meanings in different contexts. It means a relatively rigorous static supply curve in the Neo-classical sense. It means a "mongrel" type of supply estimate in the loosely defined sense. It means a time-oriented supply relation in the dynamic sense. To distinguish two of these different meanings, supply researchers use the terms *normative* long-run supply for the RFA type of model, and *positive* long-run supply for the time-series regression type of model. Unfortunately, these two terms have probably generated even more confusion. Nerlove's dynamic long-run supply response differs in meaning from the others in still another way. The incorporation of distributed lags results in a mixture of dynamics and long run—a combination that produces mixed meanings. The proliferation of meanings seems to stem from a desire to stretch the long-run supply model's use beyond its original capacity.

The time has arrived to retire the long-run supply model. In its place I suggest we use comparative statics and dynamic supply models. By use of a comparative statics framework, relations involving technological change, capital investment, institutional change, and stage of life can be brought to bear on the supply estimates through the shift parameters. The comparative static points can be tagged with calendar time without much difficulty and the linkages in time can be accomplished with the dynamic concepts of the cobweb effect, recursive relations and lagged variables.

In conclusion, I agree with Sharples that we need redirection in supply research, but I say we should take a road which offers micro-macro, spatial and time linkages in a semi-dynamic framework.

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Discussion: The Supply Function in Agriculture Revisited

W. NEILL SCHALLER

Tweeten and Quance demonstrate imagination in their use of the aggregate production function to measure national supply response for all commodities. While not denying the importance of supply elasticity at such a high level of aggregation, I suspect the authors agree that its usefulness would be enhanced if it could be combined into a larger package of information. I wonder if it would not be possible, now, to develop a consistent, integrated system of commodity supply elasticities at the U.S. level, including cross elasticities—like the demand system developed by Brandow [1].

I should think that the resulting package would contribute more to policy formulation than separate unintegrated studies, and that the system would provide a means of checking for internal consistency.

Elasticities have a long-standing conceptual and numerical meaning to the economist. But it is always difficult to prevent their misinterpretation. Tweeten and Quance recognize the problem. Still, I am not sure that they overcome the likely confusion between economic and calendar time when they define short run as "two years" and long run as "many years."

The Tweeten-Quance paper provides several relevant results, including a courageous offering of point elasticities. They tell us that ". . . there is no basis to conclude that the structure of supply changed between the postwar and prewar periods." They see little basis to conclude that output response to price has increased over time, or that the response differs for rising and falling prices. I had trouble reconciling these remarks with the different elasticities for increasing and decreasing prices, presented at the end of the paper. I suspect that my "hang up" is explained by the word, structure. The authors' results support the hypothesis that the structure of supply was different for increasing and decreasing price years. But what is this "thing" called structure? Is it captured at such a high level of aggregation?

The approach discussed by Sharples is quite different from the one found in the Tweeten-Quance paper. Sharples demonstrates that it is indeed possible to disaggregate total supply, geographically and commodity wise, while maintaining an aggregative point of view. Not many years ago, supply analysts seemed to be clearly either micro-oriented or macro-oriented. The distinction has grown fuzzy. This I regard as a healthy sign.

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Yet, we are still a long way from capitalizing on the complementarity of research techniques and of analyses cast at different levels of aggregation. I agree with Sharples that the micro-macro linkage may have to be informal. In fact, our search for a formal linkage—though scientifically appealing—may explain some lack of progress on achieving the desired complementarity.

It is perhaps significant that neither paper includes a detour into the semantics of normative and predictive research. This, too, is an encouraging sign.

The results presented by Tweeten and Quance obviously apply to output and price levels that have been experienced. Similarly, the estimates discussed by Sharples are determined in part by the range of historical experience. We all know what we are up against when we go beyond that range. But as others have surely said before me, some of our most pressing policy questions require estimates of supply response to conditions not yet experienced. Consider, for example, questions such as (1) How would output respond to substantially lower prices? (2) How much new cropland would come into production if a general cropland retirement program were enacted? (3) What would be the effects on production and income if payment limitations were imposed? These questions are *not* academic. Unfortunately, our tools seem better suited to questions that involve relatively insignificant departures from the current response environment.

The papers presented here tell me that we have made good progress since 1960 when Nerlove and Bachman wrote their important survey article on supply estimation [2]. Useful modifications of existing tools have been developed, and our research has become more mature. But is it possible that the marginal returns to improved use of traditional techniques are now well below the returns that could accrue to research on approaches that lay idle, or do not exist, in our tool kit?

For example, Nerlove and Bachman talked about the need to undertake and extend the use of the producer panel device. What has been done along this line? Could producer panels help answer questions of the kind posed above—those that take us outside of historical experience?

Several years ago, when a relative of mine asked me what my research involved, I explained that I was using mathematical techniques to estimate how farmers would respond to changes in Government programs, prices, and so on. Unimpressed, my relative replied, "If you want to know what farmers would do, why don't you ask them?" The question has nagged me ever since. To my knowledge, we have not really studied the relationship of producer plans to their expectations, nor the relation between their plans and actual behavior. Is the theoretical foundation lacking, or are we somehow tied—intellectually or organizationally—to the kinds of approaches discussed in this session?

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The Role of the Farm Foundation in Agricultural Economics

JOSEPH ACKERMAN

WHEN I first joined the staff of the Farm Foundation, I spent considerable time attending meetings and conferences. One day one of the individuals that I had seen at many of these conferences said to me, "Every place I go I see you. What is your racket, Joe?" It happened that Henry C. Taylor, who was managing director at that time, was standing next to me, and before I had time to gather my thoughts for a proper reply, he said, "Oh, he has the same function that yeast has in bread." I have often thought of that remark, and after almost thirty years, I can hardly think of a more apt reply. The Farm Foundation is, indeed, much like a leavening agent, for one of its avowed aims is to start action that is self-sustaining and self-multiplying.

The principal founder of the Farm Foundation was Alexander Legge, who was president of the International Harvester Company at the time of his death. At one time he served as chairman of the Farm Board, and this gave him an excellent opportunity to talk with many farmers, businessmen, statesmen, and educators regarding his pet project, a fund that could be used to improve rural life. No agency existed for this specific purpose at the time, and he persuaded others to join with him in sponsoring a foundation.

Frank O. Lowden, another founder, showed his belief in the usefulness of such a foundation by a bequest in his will accompanied by these words: "The quantity and the quality of the rural population is a major and most important factor in determining in the long run the strength, the character, and the well-being of the people of the nation."

The trust agreement which established the Farm Foundation in 1933 provides for the direction of its activities by a Board of Trustees of not fewer than 21 members. For purposes of insuring sound and effective management based upon broad information, seven of these Trustees are to be chosen at large; five are to be experienced in farming; three are to be selected from the executive, teaching, experimental, or extension staffs of the state universities maintaining agricultural departments; and the re-

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maining six are to represent finance, manufacturing, merchandising, transportation, farm press, and radio as a means of education.

At the first meeting of the organizing committee, Dean Chris Christensen of the University of Wisconsin was asked to obtain the help of E. G. Nourse of the Brookings Institution in investigating various possible fields of activity. In a statement that gave direction to the Board in establishing its philosophy, Dr. Nourse said:

> "If a Foundation is to render a distinctive and positive service, it must settle upon a clearly defined and limited objective of real significance and future value and devise a procedure which will be calculated to stimulate and guide the efforts of other persons or agencies toward the accomplishment of this objective so that their participation may multiply the weight of the foundation's own effort. . . . No social movement can be directed exclusively from the top leaders, however able or disinterested. The movement will 'take' only in proportion as this leadership is effectively interlocked with working relations with the full body of people whom it is designed to benefit."

Dr. Nourse went on to say that the Foundation could and should become a center of leadership and a coordinating agency in helping rural America decide what standards of living it desires and ways of removing obstacles to attainment of those standards.

The key ideas in Dr. Nourse's statement were stimulating the efforts of other agencies to multiply the Foundation's efforts and involving the people in programs designed to benefit them. The Trustees recognized that the limited funds of the Foundation could be used most effectively by supplementing and coordinating the work of other agencies and initiating and demonstrating the value of lines of work that might later be carried on by institutions with greater resources. They also recognized that the process of the farmer thinking through his problems, seeking and finding the solutions, and satisfying the urge for better living was the American free enterprise way of creating a more desirable rural life. Thus, over the years the Farm Foundation has stressed the stimulation of research and experimental work for the study of problems of importance to the rural population, the dissemination of useful information resulting from such study, and the development of understanding and community consciousness.

Dr. Taylor, who served as managing director from 1935 to 1945, was asked to spend his first year investigating the activities of other agencies interested in agriculture and rural welfare and to recommend a program. Following Dr. Taylor's report to the Board, the Board of Trustees decided upon beginning activities in four areas: land tenure, rural education, rural health, and public policies affecting agriculture. Interest in these areas has continued, but the program has been expanded and currently includes work in land economics, public policies affecting agriculture, farm management, water resources, range management, leadership training, rural sociology, agricultural marketing, rural church, and consulting services.

It seemed logical to encourage cooperation among states with similar problems, and much of the work developed more or less naturally by regions: the North Central region, the South, the West, and the Northeast. Most of our activities today are conducted through regional committees, with the state universities in each region represented on these committees. Members of the research committees are appointed by the respective agricultural experiment station directors, and members of the extension committees are appointed by the agricultural extension service directors. The U. S. Department of Agriculture is also represented on each committee. The directors appoint one of their group as administrative advisor to each committee.

In general, the objectives of the research committees are: (1) to identify important problems for study, (2) to develop effective methods for solving them, (3) to generate regional research projects, (4) to provide informal research coordination between two or more states on common problems, and (5) to review and publish manuscripts resulting from the discussions and research of the committee.

The major functions of the extension committees are: (1) to facilitate exchange of new ideas and materials, (2) to explore new methods and procedures in extension education, (3) to prepare basic training and work materials and bulletins for regional use, (4) to promote understanding of subject matter and professional improvement of extension specialists, and (5) to identify emerging problems and assume leadership in new areas of extension emphasis.

Land Economics

One of the first lines of work undertaken was in the field of land tenure for which I served as a specialist. After consulting with the heads of the departments of agricultural economics concerning how we might be most effective, we decided to bring together those interested in this area in order to attack such problems as better land use and conservation, how to attain and maintain the family type farm basic to a satisfactory rural economy, tenancy, getting established in farming, how farmers acquire ownership, and farm land prices.

A land tenure committee was organized in 1939 to undertake cooperative research in the North Central region. Later all of the other states became interested and similar committees were organized in other regions. These groups have served the members and their universities throughout the years as a guiding and coordinating force. Their work, originally confined to land tenure research, has expanded during the years to encompass a broad range of economic problems associated with land and water use. Considerable attention is given to urban problems, which in many instances are inseparable from rural problems.

The land economics committees have set a remarkable record of production of regional and state publications, which have been widely used by research and extension workers not only in this country but in countries all around the world. They have held a number of workshops to identify new problems, to determine the gaps in research, and to explore innovative research methods, thereby significantly advancing the discipline of land economics.

Rural Education

We had a formal project in rural education from 1939 to 1945. This work was under the direction of Iman E. Schatzmann, who worked with a national committee on rural education whose function was to study the conditions of rural education and to recommend ways and means of improving them. The committee, having concluded that the major concern was the quality of teaching and the relating of the work of the schools to the communities in which they were located, initiated four special projects. Three of these were demonstrations in the field of rural elementary education in Illinois, Missouri, and Oklahoma. The fourth was a project in Wisconsin to assist seven selected high schools adjust their curriculums to suit the needs of the rural student body and at the same time to develop the rural high school into a center which could better serve the entire community.

The Committee on Rural Education cooperated with the American Council on Education in holding a conference on "The Rural Child in the War Emergency," which drew national attention to the fact that war conditions threatened to deprive many country children of their educational opportunity. Over 50,000 copies of the conference report were distributed throughout the United States, and considerable radio time was provided free of charge to draw attention to the problem.

The major contribution from the Committee on Rural Education came in its final report, "Still Sits the Schoolhouse by the Road," published in 1943. This 54-page report appraises the existing system of rural education and outlines a program of action for improving it. The committee did excellent work in arousing interest in financing of schools and improvement of curriculums and in-service training. Even though the formal work ended in 1943, interest continued in a rural education project at the University of Chicago for three or four years. Then I also became involved in the public schools as a member of the local board of education, which led to participation in the state school boards association and later the national school boards association. Thus we have had a continued interest in education throughout the years.

Medical Care and Health of Rural People

Another initial project of the Farm Foundation was in medical care and health facilities in rural areas. It was believed that rural people were not receiving adequate medical care The reasons were many, including lack of awareness of the farm people of the full meaning to themselves and their families of modern preventive and curative medicine, inadequate facilities and services, the high cost of rural medical care due to the great distances involved, and failure of the medical profession to recognize the importance of the problem and the opportunities for service.

In 1939 the Farm Foundation initiated a program to help awaken rural people to the importance and possibilities of modern medical care. Financial aid was provided to the University of Nebraska Extension Service for educational work with selected local groups in the more sparsely settled areas. The farm women of Nebraska were particularly interested in this effort. Elin L. Anderson was employed to direct this work. The objective was to get farm people to confer together regarding the best methods for developing more adequate medical care programs for the area. Much attention was given to prepayment plans for medical care as a means of providing preventive as well as curative medical services.

Interest in the project spread beyond Nebraska into the states of Montana, North Dakota, South Dakota, and Wyoming, and a health program was adopted by the Northern Great Plains Advisory Council. From this organized extension effort much interest developed in other states and also among the medical associations.

The Foundation also helped to sponsor annual conferences with representatives of the major farm organizations to promote understanding of ways and means of developing interest, knowledge, and incentive among local groups to help themselves to better health. Many rural health councils were formed and action programs developed.

In 1949 a research grant was given to Michigan State College for a two-year study which resulted in a comprehensive book, *Community Health Action,* outlining how many communities had succeeded in organizing to meet their rural health needs.

The Farm Foundation continues its interest in this area through participation in the Advisory Committee of the American Medical Association's Council on Rural Health.

Public Policies Affecting Agriculture

Much time was devoted to the study of public policies affecting agriculture with the assistance of Howard J. Stover, who was employed as a statistician by the Farm Foundation in 1937. Material was published on "Immediate Backgrounds of Present Agricultural Policies and Programs" and "The Farmer in the Groupistic Regime."

Dr. Taylor helped organize the National Farm Institute at Des Moines, Iowa, as a forum for discussion of agricultural problems and also helped develop the Institute's first programs on land tenure, the farmer's stake in foreign trade, and the common interests of agriculture, labor, and industry.

He was also interested in the development of a project on world trade in agricultural products, which was supported by funds from the Rockefeller Foundation and sponsored by the International Institute of Agriculture at Rome. This work resulted in the publication in 1940 by the International Institute of Agriculture of *World Trade in Agricultural Products,* a volume of over 1,100 pages. In 1943, Dr. Taylor and his wife, Ann D. Taylor, with the assistance of the U.S. Department of Agriculture, published a summary of the volume under the same title.

Frank W. Peck, Managing Director of the Foundation from 1945 to 1954, had an extension and farm credit background. Under his direction, new emphasis was given to extension activities. In 1950, the Foundation held a national conference on agricultural policy primarily for extension directors to point out extension opportunities in this area of concern. It was felt that extension could render an important service in helping farm people develop an enlightened understanding of the economic, social, and political consequences of alternative policies, thus enabling them to participate more effectively in policy decisions.

The following year a series of regional conferences were sponsored by a national policy committee which was organized following the first conference. This national committee consisted of one extension representative, one research economist, and one extension director from each of the four extension regions. This committee has planned and conducted eighteen annual training conferences for extension economists actively engaged in public policy work. Each of these conferences has been designed to improve understanding of the major emerging agricultural policy issues. The proceedings each year have been published by the Farm Foundation in a series of reports under the title, "Increasing Understanding of Public Problems and Policies." This past year, because of the many demands we have had for these proceedings, R. J. Hildreth, Associate Director of the Farm Foundation, prepared a book of forty readings, selected from these proceedings because of their current usefulness.

The Foundation also brought together a group of eminent agricultural economists to prepare a consensus statement with respect to federal price support programs. This group presented its conclusions in a widely read booklet, *Turning the Searchlight on Farm Policy.* The group reviewed the evolution of agricultural price support legislation, influenced as it has been by war and peace, by technological progress, and inflationary disturbances. It tried to distill the lessons taught both by the experience and by the study as a basis for consideration of future plans and programs. Even though this booklet was published in 1952, there is still a tremendous demand for it.

In 1963 the Farm Foundation received a grant of $60,000 from the Ford Foundation to be used over a period of five years in support of liberal education programs for public affairs specialists and administrators in the agricultural extension services. Plans for this project were developed by the National Agricultural Policy Committee in cooperation with the Center for Agricultural and Economic Development of Iowa State University, the Agricultural Policy Institute of North Carolina State University, and the Federal Extension Service. The four regional committees established under this program have been tremendously productive during the short period of their existence. They have prepared numerous publications for use by extension workers in their respective regions. They have prepared a set of slides and an accompanying script to be used in conjunction with a manual, "Your Part in Agricultural Policy." They cooperated with the national committee in the development of a series of extension leaflets on "People and Income in Rural America." These leaflets explore both the commercial farm problem and the low-income problem in rural America.

A number of important activities were undertaken through a coordinating committee consisting of representatives of the National Agricultural Policy Committee, the Center for Agricultural and Economic Development of Iowa State University, the Agricultural Policy Institute of North Carolina State University, the Federal Extension Service, and the Farm Foundation. This group prepared a series of leaflets on "The Farm Problem—What Are the Choices?" It also prepared a series of leaflets on "World Trade: What Are the Issues?" as well as a third series of leaflets on "Developing Human Resources for Economic Growth." In 1968, this group held a seminar to explore the relevance of university research and education, particularly in the social sciences, to existing and emergent social problems.

Each year financial assistance is provided to 100 county agents from the various states to attend three-week training courses in agricultural policy, which are offered at Colorado State University and the University of Arizona. These scholarships have been provided since 1953.

Farm Management

The North Central Farm Management Research and Extension Committees were organized in 1946 and were soon followed by the establishment of similar committees in the South, the Northeast, and the West. Currently all 50 states are represented on the four regional farm management research committees and all states except Alaska are represented on the four regional farm management extension committees.

The research committees have been active over the years in the development of research projects, many of which became established as independent technical projects. One of the more productive technical projects in the North Central region was a regional study of decision-making processes. The findings were published by Iowa State University Press in a book, *A Study of Managerial Processes of Midwestern Farms.* A Southern technical study of farming adjustment opportunities, terminated in 1968, resulted in a regional publication, "Cotton: Effects of Allotments on Supply and Farm Resource Use." Many state publications also have resulted from this project.

More important perhaps than the regional projects have been the cooperative efforts in holding workshops and seminars on methodological approaches to farm management problems. The early discussions by the committees, both formal and informal, had a significant bearing on both the direction of methodology and the progress in farm management research. The current discussions of the implications of structural changes in agriculture for farm management research will undoubtedly point up areas requiring research in the years ahead.

Many publications have also resulted from the cooperative efforts of the extension committees. Yet I feel that probably the most significant contribution of the committees in recent years has been their exploration of the question of farm management in the years ahead. A regional workshop held in the North Central states was attended by most of the farm management extension personnel in the region, Federal Extension Service representatives, and many visitors. The objective of this workshop was to contribute to professional improvement of participants through appraisal of the economic climate and the educational needs of changing clientele groups and examination of new approaches in filling these needs.

In looking ahead, we can see that sound decision making, which is basic to good farm management, will require the consideration of an increasing number of factors. It will call for the application of the principles of economics to specific problems, a knowledge of the many economic forces affecting the farm business, and an evaluation of new technologies. The farm management committees are trying to develop programs to meet these needs.

Water Resources and Range Management

Closely related to land economics and farm management are the committees on water resources and range management of the Western Agricultural Economics Research Council, which are supported from a grant made by the Foundation to the Council.

The reports of conferences sponsored by the Water Resources Committee continue to serve as an important source of reference material. The committee prepared a book dealing with economics and public policy in water resource development comprised of chapters written by leading economists in the field. The demand for the book indicates that it has met a need for authoritative material on the subject.

The Range Use and Development Committee initiated a project, W-79, Economic Analysis of Range and Ranch Management Decisions on Western Livestock Ranches. As a part of this project, several states have prepared basic budget data for more than two hundred specific ranching situations. Recently much attention has been given to economic analysis of the demand for outdoor recreation.

Leadership Training

The Foundation initially was interested in improving the work of the departments of agricultural economics and provided funds to the University of Chicago from 1938 to 1942 for scholarships for agricultural economists. Mr. Peck renewed the program of providing scholarships for a year's training, but the emphasis was changed and the scholarships were made available to extension workers, particularly those responsible for extension supervision and administration. The theory behind this change in emphasis was that the training provided would benefit not only the extension workers but also extension's large clientele, the farm people. These scholarships have been provided since 1947. In addition, the Foundation has since 1950 provided 20 scholarships to supervisors each year to attend the extension summer school course for extension supervisors.

Between 1946 and 1953 funds were provided for four workshops for extension administrators, two workshops for home demonstration leaders, and an extension visual aids workshop. All of these workshops were designed to increase understanding of the roles and responsibilities of extension workers and to improve the effectiveness of extension programs.

Two series of workshops which the Foundation helped sponsor played a very important role in the improvement of agricultural instruction. The first was a series of workshops for the Southern states on improvement of college teaching in agriculture. The discussions centered on concepts and principles of teaching, evaluating the effectiveness of teaching, means of improving teaching, and improving the teacher as a person. The funds for this series of five conferences came primarily from the Danforth Foundation.

The second series of workshops, for deans and directors of resident instruction in agriculture, were held on a national basis. Five workshops have been held, and currently a second series of five workshops are being held with a grant to the Farm Foundation from the Sears-Roebuck Foundation. The purpose of these workshops is to bring together those who have major administrative responsibility in resident instruction for discussion of problems associated with both curriculum and personnel. These workshops have resulted in many adjustments in college curriculums with a view to providing more adequate training for a highly technical commercial agriculture.

Rural Sociology

In 1947 the directors of agricultural experiment stations approached the Farm Foundation concerning support for a committee in rural sociology. As a result of the initial meeting with the directors, the Foundation sponsored in 1949 a comprehensive study of the research and extension activities of the land-grant universities and colleges in rural sociology. The report of this study, conducted under the leadership of F. D. Farrell, President Emeritus of Kansas State College, was published in 1950 under the title, "Human Relations in Agriculture and Farm Life." The report was presented to the Rural Sociological Society at its annual meeting in 1950, and the Society recommended that the Foundation sponsor a conference or workshop to study the main issues defined in the report. The Society felt that some of the causes of frustration among rural sociologists and the problems involved in the training of rural sociology personnel required special attention.

This interest, along with urging from the directors of agricultural experiment stations, led the Foundation to organize a committee of research and extension representatives in the North Central region in 1951. Without going into detail, let us just say that this committee has had a greater impact on the research and extension activities in its field throughout the region and throughout the United States than any other one committee that we support. The committee has made tremendous strides in important areas, including the diffusion and acceptance of new ideas among farmers, the social process, resident and extension teaching in rural sociology, career choices of rural youth in a changing society, the role of leadership in the social system, and many more.

We now have a rural sociology committee in each of the four regions. All of these committees are concerned with the stimulation and improvement of work in rural sociology and the contributions which improved knowledge of human relations can make to other disciplines and to agriculture.

Agricultural Marketing

The Farm Foundation sponsors four extension marketing committees and has actively participated in the work of the Western Research and

North Central Research Committees. The four regional extension marketing committees define problems and develop and conduct educational programs on a regional and coordinated state basis to assist farmers, managers of marketing firms, and consumers with marketing decisions. They have also devoted major efforts to training to improve the competency of marketing specialists and the field staffs in the respective regions. The research committees have made significant contributions toward understanding of market structure and marketing efficiency.

The marketing system has grown in size and also influence. It is demanding higher and more uniform quality and is setting other specifications for farm products. It is exerting a strong influence on the structure of agriculture. Consequently, the marketing committees will have to continue to study the impact of marketing upon agriculture and to identify and evaluate alternative methods of accomplishing market objectives. Currently the committees are giving considerable attention to the question of bargaining as a part of the marketing process.

Rural Church

Another project that has perhaps received less recognition than the others is the Farm Foundation's work with church groups. One of the early ideas of the Foundation was that rural pastors could minister more effectively to the spiritual life through better understanding of the economic realities of rural life and ways of working more successfully with people. Grants-in-aid were made from 1939 to 1944 to three institutions for teaching agricultural economics and rural sociology to rural pastors in summer short courses. These institutions were the Garrett Biblical Institute, the National Catholic Rural Life Conference, and the Pacific School of Religion. Over the years this program has expanded until it includes ten institutions.

The Foundation has also given financial aid to the Committee on Continuing Education for Town and Country Pastors at the Land-Grant Universities. This committee prepared a brochure outlining areas of needed church oriented research and suggested areas of instruction at land-grant universities for developing better economic understanding among those responsible for religious activities in smaller communities. The committee also sponsored a series of regional two-week schools for pastors to develop understanding of economic trends and social processes and the role of the church in the community.

History of Agricultural Economics

Following retirement from his position as managing director of the Farm Foundation, Dr. Taylor and his wife, Ann D. Taylor, wrote a book, *The Story of Agricultural Economics in the United States, 1840–1932,* under the sponsorship of the Farm Foundation. This comprehensive historical treatment of the men, services, and ideas that contributed to the growth of agricultural economics was published in 1952 and still is widely used as a reference.

Conclusion

One of the important roles of the Farm Foundation has been that of coordinator. The regional committees of land-grant university and U.S. Department of Agriculture personnel which we sponsor have proved a most effective approach to coordination. They have provided a means of pooling experience and thinking in studying problems which extend beyond state borders. They have helped avoid duplication of effort and have saved time and money for the research and extension agencies. Coordination has led to integration of activities of limited scope into larger more meaningful undertakings. It has provided a broader view of problems, facilitated long-time planning, and given more effective direction to the work. In short, it has led to better results from the limited funds available.

Another role that the Farm Foundation has filled is that of innovator. Through our committees and through workshops we have tried to provide an environment conducive to creative thinking. The discussions have stimulated imaginative new ideas for conducting both research and extension activities. Such discussions led to the application of linear programming methods to farm management problems. Through the efforts of the farm management extension committees, projects have been developed for electronic processing of farm records to provide farmers more promptly with data for farm business analysis. The land economics committees have enlisted the aid of lawyers in studying the legal aspects of land economics problems. These are but a few examples of new approaches devised by the committees.

A third role of the Farm Foundation has been that of educator. It has provided funds for training conferences and training courses and for publishing and distributing the results of conferences and studies. The purpose of this education has been professional improvement of researchers and educators as well as broadening of the concepts and understanding of the people. The end objective has been the development of sound economic thinking to enable people to act responsibly and wisely in making their own decisions.

Still another role of the Foundation has been that of "lookout." The Farm Foundation and its committees continue to scan the horizon for emerging problems. The committees continually reorganize and redirect their programs to fill the continuing need for knowledge to keep ahead of our dynamic agriculture. The first major reorganization in the over-all regional work in agricultural economics has recently taken place in the West, where the committees on farm management, marketing, water resources, and range use have been restructured into three committees on commercial agriculture, natural resource development, and community and human resources development. The Western Agricultural Economics Research Council felt that this restructuring would lead to more meaningful research through consideration of problems in a broader and more realistic context.

If we have in a small way succeeded in helping to direct attention to problems of the over-all economy as well as to solving day-to-day problems of the farmer and his family, if our work has helped provide farmers with information to aid them in acting intelligently and effectively in private matters concerning the efficiency of their operations and in public matters affecting their welfare, then our work has been most worth while.

THE POTENTIAL ROLE OF CONTROL THEORY IN POLICY FORMULATION FOR THE U.S. AGRICULTURAL INDUSTRY

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What Does Control Theory Have to Offer?*

GERHARD TINTNER

WE INTRODUCE a few definitions. We have a system, in our examples simple linear difference or differential equations connecting certain inputs and outputs. There is a control variable which should enable us to produce some desired output. The output is the controlled variable. Open loop control exists where the output has no effect upon the input. Feedback provides the means of feeding back the output in order to enable a comparison with the desired output. Closed loop control means a system where output has effect on the input in order to obtain the desired result. Adaptive systems take change in the environment into account, especially stochastic variations.

1. Deterministic models

One of the most interesting developments in modern economics is the utilization of ideas which have proven their usefulness in electrical and communications engineering [1, 21, 22, 16]. In a sense, these ideas correspond to the economic concept of a multiplier [1].

We shall illustrate control theory with the help of a very simple problem in agricultural production in India. Using Indian data for 1951–52 to 1963–64 [20] and denoting by A_t real per capita agricultural production and by E_t real per capita government expenditure on agriculture in India, we derive empirically the following relation:

$$A_t = 0.0463 + \underset{(0.14723)}{0.87325\, A_{t-1}} + \underset{(1.7068)}{1.21524\, E_{t-4}} \tag{1}$$

The multiple correlation coefficient is 0.94012, its square $R^2 = 0.883$ shows, that about 88% of the total variance of Indian per capita agricultural real

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production is explained by the relation. The figures in brackets below the regression coefficients denote standard errors.

This equation is easily integrated and gives the general relation for A_t using the observed values of A_{12} and $E_t (t \leq 12)$

$$
\begin{aligned}
(2) \qquad A_t = {} & 0.36529 + 1.09681(0.87325)^{t-3} + 1.70681 \\
& + [(0.0211)(0.87325)^{t-4} + 0.0278(0.87325)^{t-5} \\
& + 0.0338(0.87325)^{t-6} + 0.0516(0.87325)^{t-7} \\
& + 0.0619(0.87325)^{t-8} + 0.0360(0.87325)^{t-9} \\
& + 0.0379(0.87325)^{t-10} + 0.0405(0.87325)^{t-11} \\
& + 0.0417(0.97325)^{t-12} + 0.0437(0.87325)^{t-13} \\
& + 0.0452(0.87325)^{t-14} + 0.0529(0.87325)^{t-15} \\
& + 0.0548(0.87325)^{t-16} + E_{13}(0.87325)^{t-17} \\
& + E_{14}(0.87325)^{t-18} + \cdots + E_{t-4}] \qquad (t \geq 17)
\end{aligned}
$$

Imposing the condition that $A_t \geq A_{16} = 0.8854$ (agricultural production for 1967/68) we derive:

$$
(3) \qquad A_t \geq 0.0542
$$

The sum:

$$
\begin{aligned}
(4) \qquad S = {} & A_{17} + A_{18} + A_{19} + A_{20} + A_{21} = 3.5901 + 4.7189E_{13} \\
& + 4.012E_{14} + 3.2031E_{15} + 2.2764E_{16} + 1.21524E_{17}
\end{aligned}
$$

This is the sum of agricultural production 1968/69 to 1972/73. We want to maximize it under the condition that $A_t \geq A_{16} = 0.8854$ for $t = 17$, 18, 19, 20, 21. This is to say, agricultural production should in no year be smaller than in 1967/68. This implies that $E_t \geq 0.0542$ for $t = 13$, 14, 15, 16, 17. The E_t, government expenditure on Indian agriculture, real per capita, are our control variables. If the total expenditure available $E = E_{13} + E_{14} + E_{15} + E_{16} + E_{17} > 5(0.0542) = 0.2710$, then the best allocation is as follows: Allocate $E_{13} = E - 0.2710$, $E_{14} = E_{15} = E_{16} = E_{17} = 0.0542$.

A very important idea in deterministic control theory is the maximum principle of Pontryagin [6]. A special version of Pontryagin's maximum principle [11, 6] is due to Rozonoer [11]. Assume we have a number of n variables $x_i(t)$ $(0 \leq t \leq T)$ and we want to maximize

$$
F = \sum_{i=1}^{n} c_i x_i(T)
$$

i.e., a linear function of the terminal state of the system. The system is described by the differential equations:

$$
(5) \qquad \dot{x}_i(t) = f_i(x_1, x_2, \cdots, x_n, u_1, u_2, \cdots, u_m) \qquad i = 1, 2, \cdots, n
$$

where dots denote time derivatives, $x(0) = x_0$ and the u_j are controls, which are constrained to lie in a closed set U.

We form the Hamiltonian:

$$H = \sum_{i=1}^{n} p_i f_i \tag{6}$$

The conditions:

$$\dot{x}_i = \partial H / \partial p_i \tag{7}$$

give us the above system of differential equations (5). From:

$$\dot{p}_i = -\partial H / \partial x_i \tag{8}$$

and $p_i(T) = c_i$ we determine the $p_i(t)$. The condition:

$$M = \max_{u_k} H \tag{9}$$

gives the optimal controls [3].

If we use the integral of our difference equation derived empirically from Indian data for food production in India we have:

$$dA(t)/dt = A(t) = 0.0463 - 0.135A(t) + 1.21524E(t-4) \tag{10}$$

We want to maximize $A(20)$, i.e., agricultural production in 1971/72.

We form the Hamiltonian:

$$H = p(t)[0.0463 - 0.135A(t) + 1.21524E(t-4)] \tag{11}$$

From

$$A(t) = \partial H / \partial p \tag{12}$$

we get again the above differential equation for $A(t)$, (10).

$$\dot{p}(t) = -\partial H / \partial A = 0.135p(t) \tag{13}$$

and the condition: $p(20) = 1$ gives:

$$p(t) = 0.067e^{0.135t} \tag{14}$$

We see from the Hamiltonian, that for a maximum $E(t-4) = \text{sign } p(t)$. If we have the condition that $0 \leq E(t) \leq E$, where E is a constant (the maximum expenditure for agriculture available) then we must make $E(t) = E$.

Using the last observation $A(12) = 0.9401$ and finding the integral of (10), we derive from $A(20)$:

$$A(20) = 0.360 + 9.002E \tag{15}$$

Hence, if $E = 0.05$, like in recent years $A(20) = 0.810$, indicating a strong decline of real per capita agricultural production in India if government expenditure is not increased. However, if we make $E = 0.1$, roughly a doubling of recent government expenditure on agriculture in India, we obtain: $A(20) = 1.260$, an increase of 34% over the last observed agricultural production.

A discrete version of the maximum principle is given by Rozonoer [12]. See also [4]. Consider n first order difference equations in the variables $x_{1t}, x_{2t} \cdots x_{nt}$

$$x_{it+1} - x_{it} = \Delta x_{it} = f_i(x_{1t}, x_{2t} \cdots x_{nt}, u_{1t}, u_{2t} \cdots u_{mt}, t) \quad i = 1, 2, \cdots, n \tag{16}$$

Here the u_{jt} are control variables and must lie in a closed set U. The object is the maximization of

$$S = \sum_{i=1}^{n} c_i x_{iT} \tag{17}$$

where x_{iT} is the terminal value.

We introduce n function of time p_{it} and form the Hamiltonian:

$$H = \sum_{i=1}^{n} p_{it} f_i \tag{18}$$

We have:

$$\Delta x_{it} = \partial H / \partial p_{it} \tag{19}$$

which gives us the above system of difference equations (16).

$$\Delta p_{it-1} = - \partial H / \partial x_{it} \tag{20}$$

and the boundary conditions:

$$x_{i0} = a_i \tag{21}$$

$$p_{it-1} = c_i \tag{22}$$

Then the maximum principle says: Find the maximum:

$$M = \underset{u_j}{\text{Max}}\, H \tag{23}$$

which will determine the optimal controls.

Consider now the previous model of agricultural production in India. We derive the relation:

$$A_{t+1} - A_t = \Delta A_t = 0.0463 - 0.12695 A_t + 1.21424 E_{t-3} \tag{24}$$

Now we form the Hamiltonian function:

$$H = p_t(0.0463 - 0.12685 A_t + 1.21524 E_{t-4}) \tag{25}$$

If we want to maximize A_{20} i.e., agricultural production for 1971/72 we have:

(26) $$\Delta A_t = \partial H/\partial p_t$$

which is the above difference equation for A_t (24). Also:

(27) $$\Delta p_{t-1} = -\partial H/\partial A_t = 0.12685 p_t$$

with the initial condition:

(28) $$p(20) = 1$$

This gives $p_t = 0.066\ (1.145)^t$. We see from the Hamiltonian that the maximum is given by $E(t\text{-}4) = \text{sign}\ p_t$. If again $0 \leq E_t \leq E$ we must make $E_t = E$ in order to attain the optimum.

Using formula (2) we obtain for $A(20)$:

(29) $$A(20) = 0.768 + 5.633E$$

For $E=0.05$, $A(20)=1.05$, i.e., agricultural production similar to the present value. If $E=0.1$ $A(20)=1.33$ i.e., if real per capita government agriculture is approximately doubled, there will be an increase of about 41% in real per capita agricultural output in India in 1971/72.

The following is based upon [3]. See also: [15, 19]. Consider first a continuous deterministic control problem. Given an initial time t_0 and a terminal time T, also that

(30) $$x(t_0) = x_0$$

We want x to get to the origin $x=0$ and the cost is:

(31) $$C = \int_0^T u^2(t)dt + x^2(T)$$

where the first term denotes the cost of control, the second the deviation from the origin. The motion of x is given by:

(32) $$dx/dt = ax(t) + bu(t)$$

Introduce a Lagrange multiplier $L(t)$. We have:

(33) $$dL/dt = -aL$$

(34) $$L(T) = 2x(T)$$

Optimal control is given by:

(35) $$2u + Lb = 0$$

Hence we have:

(36) $$L(t) = 2x(T)e^{a(T-t)}$$

$$u(t) = -x(T)be^{a(T-t)} \tag{37}$$

Control varies exponentially with time.

The ultimate results are:

$$x(T) = \frac{e^{a(T-t)}x(t)}{1 - (b^2/2a) + (b^2/2a)e^{2a(T-t)}} \tag{38}$$

$$u(t) = \frac{be^{2a(T-t)}x(t)}{1 - (b^2/2a) + (b^2/2a)e^{2a(T-t)}} \tag{39}$$

This is the feedback solution. The same result might be obtained by dynamic programming [2, 4, 9].

Applying these methods to our example of agricultural production in India, we minimize:

$$F = \int_0^T u^2(t)dt - A(T)^2 \tag{40}$$

This is the same as maximizing the terminal value $A(T)$ and minimizing the cost $u(t)$: $u(t) = E(t-4)$.

The conditions are:

$$A(t) = 0.0463 - 0.135A(t) + 1.21524u(t) \tag{41}$$

We introduce a Lagrange multiplier $L(t)$ and form the expression:

$$G = u^2(t) + L(t)[A(t) - 0.0463 - 0.135A(t) - 1.21524u(t)] \tag{42}$$

The boundary conditions are:

$$A(12) = 0.9401 \tag{43}$$

$$L(T) = 2A(T) \tag{44}$$

we find the necessary conditions for a minimum:

$$\partial G/\partial u = 2u(t) - 1.21524L(t) = 0 \tag{45}$$

$$d(\partial G/\partial A)/dt = (\partial G/\partial A) \tag{46}$$

$$\dot{L}(t) = 0.135L(t) \tag{47}$$

The results are:

$$L(t) = 2A(T)e^{-0.135T+0.135t} \tag{48}$$

$$u(t) = 1.21524e^{-0.135T+0.135t} \tag{49}$$

$$\begin{aligned} A(t) &= 0.342 + [3.050 - 117.214A(T)e^{-0.135T}]e^{-0.135t} \\ &\quad + 4.501A(T)e^{-0.135T+0.135t} \end{aligned} \tag{50}$$

$$A(t-4) = 0.342 + 5.234e - {}^{0.135t} - 201.139A(T)e^{-0.135T}e^{-0.135t} + 2.624A(T)e^{-0.135T+0.135t} \tag{51}$$

$$A(t) = \frac{A(t-4) - 0.342 - 5.234e^{-0.135t}}{2.624e^{-0.135T+0.135t} - 201.139e^{-0.135T-0.135t}} \tag{52}$$

Finally, since:

$$u(t+4) = E(t) = 2.085e^{-0.135T+0.135t} \tag{53}$$

we have for the control variable:

$$E(t) = \frac{2.085A(t) - 0.713e^{-0.135t} - 10.913}{2.624 - 201.139e^{-0.135t}} \tag{54}$$

Assume that for $t = 15$ we have $A(t) = 1$. Then the optimal $E(t)$ from formula (53) is $E(15) = 0.588$, but this is about ten times the current government expenditure on agriculture. This feedback relation gives the control variable $E(t)$ (real per capita government expenditure on agriculture in India) as a function of the contemporary state variable $A(t)$ (real per capita agricultural production in India).

2. Stochastic models

A possible generalization of deterministic control theory consists in the assumption that all parameters involved are random variables with a known joint probability distribution. The methods used in the following models are neither very realistic nor efficient. But they point to the need of taking the random influences in economics into account as much as policy decisions are concerned [22].

Consider now a continuous stochastic problem [3]. Let x be determined by:

$$x(t+\Delta t) = x(t) + [ax(t) + bu(t)]\Delta t + \xi(t)(\Delta t) \tag{55}$$

where $\xi(t)$ is stochastic process with:

$$E\xi(\Delta t) = 0 \tag{56}$$

$$E\xi^2(\Delta t) = \sigma^2\Delta t \tag{57}$$

$$E\xi^n(\Delta t) = 0(\Delta t) \qquad n > 2 \tag{58}$$

$\xi(\Delta t_1), \cdots \xi(\Delta t_n)$ are independent in not overlapping intervals $\Delta t_1, \cdots \Delta t_n$. E is mathematical expectation. If $z(t)$ is a Brownian motion process

$$\xi(\Delta t) = \Delta z_t = z(t+\Delta t) - z(t) \tag{59}$$

We wish to minimize:

$$E\int_{t_0}^{T} u^2(t)dt + x^2(T) = \int_{t_0}^{T} u^2dt + [Ex(T)]^2 \tag{60}$$

One solution of this problem might be obtained by the certainty equivalent. We replace the stochastic process $\xi(\Delta t)$ by its mean value, zero [17, 18, 14, 13]. Let $f(x, t)$ be the minimum value of the objective function:

$$f(x, t) = \min_u E_\xi[u^2\Delta t + f\{x + (ax + bu)\Delta t + \epsilon, t + \Delta t\}] \tag{61}$$

$$0 = \min_u [u^2 + (\partial f/\partial x)(ax + bu) + 1/2\sigma^2(\partial^2 f/\partial x^2) + (\partial f/\partial t)] \tag{62}$$

$$u = -b(\partial f/\partial x)/2 \tag{63}$$

The result is the same as in the deterministic case [36, 38].

Now we assume that the variance of $\xi(t)$ depends upon the control decision, with no randomness in the evolution of x if no control is exerted.

$$E[\xi(\Delta t)]^2 = u^2\sigma^2\Delta t \tag{64}$$

where σ is a constant. The criterion function is simply

$$E[x(T)^2] \tag{65}$$

$$x(t + \Delta t) = x(t) + [bu(t)]\Delta t + \xi(t)\Delta t \tag{66}$$

Open loop control implies that the variance of $x(T)$ is:

$$\int_{t_0}^{T} u^2(t)\sigma^2 dt \tag{67}$$

and the criterion function is:

$$[Ex(T)]^2 + \int_{t_0}^{T} u^2\sigma^2 dt \tag{68}$$

Now the Lagrange multiplier is a constant, $L = 2Ex(T)$.

Optimal control is given by:

$$u(t) = E[x(T)]b/\sigma^2 \tag{69}$$

We find empirically in our example for Indian agricultural production: $b = 1.21524$ and $\sigma^2 = 0.049246$. Hence the optimal control if we minimize $\int_{t_0}^{T} u^2(t)dt - [Ex(T)]^2$ is given by:

$$E(t - 4) = EA(T)(24.677) \tag{70}$$

This is the same as:

$$u(t) = \frac{x(t)}{b[T - t + (\sigma^2/b^2)]} \tag{71}$$

In our example this is:

$$E(t-4) = u(t) = \frac{A(t)}{1.21524(T-t) + 0.033349} \tag{72}$$

$$E(t) = \frac{A(t-4)}{1.21524(T-t-4) + 0.033349} \tag{73}$$

The expected terminal value of x is given by

$$Ex(T) = \frac{\sigma^2 x(t_0)}{b^2[T - t_0 + (\sigma^2/b^2)]} \tag{74}$$

In our example

$$EA(T) = \frac{0.033349A(t_0)}{T - t_0 + 0.033349} \tag{75}$$

The variance of the random variable $x(T)$ is:

$$\sigma^2_{x(T)} = \frac{\sigma^2 x^2(t_0)(T - t_0)}{b^2[T - t + (\sigma^2/b^2)]^2} \tag{76}$$

This is in our example:

$$\sigma^2_{A(T)} = \frac{0.033349A^2(t_0)(T - t_0)}{(T - t + 0.03349)^2} \tag{77}$$

The value of the criterion function is:

$$E[x(T)]^2 = \frac{\sigma^2 x^2(t_0)}{b^2[T - t_0 + (\sigma^2/b^2)]} \tag{78}$$

This is in our example:

$$E[A(T)]^2 = \frac{0.033349A(t_0)^2}{T - t + 0.03349} \tag{79}$$

Open loop optimal feedback proceeds as follows: The equation of motion is:

$$x(t + \Delta t) = x(t) - \frac{x(t)\Delta t}{T - t + (\sigma^2/b^2)} + \xi(\Delta t) \tag{80}$$

Let $f(x, t) = E[x(T)]$
Dynamic programming [2, 9] gives:

$$f(x, t) = E_\xi\left\{ f\left[x - \frac{x\Delta t}{T - t + (\sigma^2/b^2)} + \xi, t + \Delta t \right] \right\} \tag{81}$$

Letting $\Delta t \to 0$

$$(82)\qquad 0 = x(\partial f/\partial x)/[T - t + (\sigma^2/b^2)] + x^2\sigma^2(\partial^2 f/\partial x^2)/2b^2[(T - t + (\sigma^2/b^2)]^2 + (\partial f/\partial t)$$

Hence:

$$(83)\qquad f(x, t) = x^2 \exp\{1 - \sigma^2/b^2[(T - t + (\sigma^2/b^2)] + 2\log(\sigma^2/b^2) - 2\log[T - t + (\sigma^2/b^2)]\}$$

$$(84)\qquad E[x^2(T)] = \sigma^2 x(t_0)/b^2[T - t_0 + (\sigma^2/b^2)]$$

This is again the same result as for the pure open loop process (78).

For feedback we use the optimality principle of dynamic programming. Let now $f(x, t)$ be the value of the criterion if we start with x at time t: $t_0 < t < T$.

$$(85)\qquad f(x, t) = \min_u E_\xi[f(x + bu\Delta t + \xi, t + \Delta t)]$$

$$(86)\qquad 0 = \min_u [bu(\partial f/\partial x) + 1/2u^2\sigma^2(\partial^2 f/\partial x^2) + (\partial f/\partial t)]$$

This yields after some transformations:

$$(87)\qquad f(x, t) = [\exp - (b^2/\sigma^2)(T - t)]x^2$$

$$(88)\qquad u = bx/\sigma^2$$

In our example:

$$(89)\qquad f(A, t) = \exp - 0.033349(T - t)A^2(t)$$

$$(90)\qquad u(t) = 24.677A(t)$$

This is evidently a very unrealistic solution.
Let now $h(x, t)$ be the expected terminal value of x using this control. Dynamic programming gives:

$$(91)\qquad h(x, t) = E_\xi h[x - (b^2x/\sigma^2)\Delta t + \xi, t + \Delta t]$$

with the boundary condition:

$$(92)\qquad h(x, T) = x$$

The solution is:

$$(93)\qquad h(x, t) = e^{-(b^2/\sigma^2)(T-t)}x$$

This gives for our example, dealing with agricultural production in India:

$$(94)\qquad h(A, t) = e^{-.033349(T-t)}A(t)$$

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Control Theory for Agricultural Policy: Methods and Problems in Operational Models*

OSCAR R. BURT

IN VIEW of the large amount of research by agricultural economists that leans heavily for justification on its contribution to policy decisions, it is surprising that so little effort has been devoted to systematic utilization of such research. Or considered from the other side, we might have expected more research devoted explicitly to utilization of objective information for policy purposes, and that work could exert its influence on the research that purports to be policy oriented. We have apparently conceived policy decisions as being of such a subjective nature that researchers should stop short of anything like an optimization model for policy purposes. An exception to this point of view is that expressed in the recent book by Fox, Sengupta, and Thorbecke [5].

Recently, there has been an inclination to move further in the direction of trying to quantify social costs asssociated with various policy actions [11, 12, 16, 17], but we need to go another step by using these quantitative measures in the objective function of an intertemporal optimization model. Gustafson's pioneering work in models for optimal grain storage is an example of the direction that we should be moving [7], as is also the general theory of economic policy set out in [5].

Such models take us into the realm of modern control theory. Control theory encompasses not only recent extensions of the calculus of variations, including Pontryagin's work [13], but also discrete time optimization models such as Rosen's convex programming formulations [14] and Bellman's dynamic programming [3]. The latter encompasses the methodology used by Gustafson in his storage control models. Although the classical continuous time models are most applicable to physical phenomena, the discrete time models are usually better adapted to economics. Most decision problems in economics are periodic, and in agriculture, the period is often a year. Of course, economic problems can be approximated by continuous variational models, but numerical solution of these models usually requires discrete approximation methods. Therefore, it would seem advantageous to use a discrete model at the start since it is more realistic and can be solved directly. One advantage of a continuous model is the ability to treat end points of the time horizon analytically through the transversality conditions. For numerical analysis, the discrete model is satisfactory on this point, too, because the time horizon can be arbitrarily extended until the solution values

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of the control and state variables in the terminal period indicate that any addition to the time horizon would be redundant.

The discussion of this paper is in the context of discrete time, but for those accustomed to continuous time control theory, the conceptual basis is essentially the same. We assume a multi-stage decision process, where a stage is defined by an interval of time, say, a year. The criterion function is taken as the sum of discounted returns (costs) over all stages; the specific definition of returns (costs) is delayed until later. The following variables and relationships are basic elements of the model:

s_t is a vector of state variables that describes the decision process at any given stage t;

x_t is a vector of decision variables that is subject to control at each stage t;

$s_{t+1}=s_t+f(x_t, s_t)$ is a difference equation that expresses the state vector in stage $t+1$ as a function of the state and decision vectors in stage t;

$G(x_t, s_t)$ is the return (cost) function that associates a value with each combination of state and decision at each stage;

β is a discount factor constrained by $0<\beta<1$.

We will be considering control problems of the form

$$\max_{x_t} \sum_{t=0}^{T} G(x_t, s_t)\beta^t \tag{1}$$

subject to

$$s_{t+1} = s_t + f(x_t, s_t),\ s_0 = K;\ x_t \epsilon R(s_t),$$

where $R(s_t)$ is a region to which the control vector is constrained. For simplicity, the function $G(x_t, s_t)$ has not been made explicitly a function of time.

Temporal decision models are necessary for agricultural policy because of lagged supply responses and opportunities for storage of many commodities. Lags in consumer adjustments may also be of some importance, but are likely to play a minor role compared to storage and lags in supply. Storage is of particular importance for crops that are subject to large variations in production beyond the control of farmers, such as dry-land wheat production in the Great Plains. State variables of policy decision models will usually be functions of lagged prices and/or quantities of commodities in storage. Models that involve livestock will probably contain inventories of livestock groups, such as beef cows, as state variables. Control variables can take several forms such as prices, quantities, and acres planted.

Space does not permit coverage of stochastic models in the discussion below, but the most critical part of the model where random elements enter is in the difference equation. In many formulations, $f(x_t, s_t)$ is a random variable which requires a Markovian sequential decision model [10]. Often $G(x_t, s_t)$ is a random variable, but this is easily handled by an expected value criterion.

An illustrative example may clarify the relevance of (1) as an aid to agricultural policy decisions. Administered prices for fluid milk are institutionalized in the United States to such an extent that we seldom question the practice. Control theory in conjunction with reliable estimates of demand and supply equations can provide an objective basis for pricing. We specify a set of plausible assumptions for the structure of demand and supply equations in a hypothetical dairy region operated under administered prices. For simplicity, we take actual price instead of minimum price paid to farmers as the control variable and begin with a criterion of net returns to farmers, although a social value criterion is discussed later. Use of minimum prices, as is found in most marketing orders, would merely change the lower bound on price (the control variable) since a minimum price below some level would be ineffective and market equilibrium price would prevail. We abstract from seasonal pricing difficulties and it is convenient to think of the decision period as a year.

We assume a distributed lag supply equation

$$q_t^s = b_0 + b_1 P^f{}_{t-1} + b_2 p^m{}_{t-1} + b_3 q^s{}_{t-1}, \tag{2}$$

and separate demand equations for fluid and manufacturing utilization

$$\begin{aligned} q_t^f &= a_0 - a_1 p_t^f \\ p_t^m &= c, \end{aligned} \tag{4}$$

where the superscripts f, m, and s denote fluid milk, manufacturing milk, and total milk supplied, respectively. The constant price demand equation for the manufacturing market implies that the region is a small part of the total market. Total utilization of supply implies the identity, $q_t^s = q_t^f + q_t^m$, and the above are farm level price relationships.

The supply equation with lagged explanatory variables is the source of a nontrivial intertemporal decision problem. Otherwise, in the absence of storage, pricing decisions would be static and each period could be optimized independently. The control variable is p_t^f, price in the fluid market. State variables are p_{t-1}^f and q_{t-1}^s which stem from the supply equation (2). Lagged price of manufacturing milk, p_{t-1}^m, is not required as a state variable as a result of the simplified demand equation (4).

To avoid confusion in writing the difference equations, let the state variables be

$$s_t^1 = p_{t-1}^f \quad \text{and} \quad s_t^2 = q_{t-1}^s, \tag{5}$$

and the decision variable be $x_t^1 = p_t^f$. The two difference equations are

$$(6)\qquad s_{t+1}^1 = x_t^1 \quad \text{and} \quad s_{t+1}^2 = b_o + b_1 s_t^1 + b_2 c + b_3 s_t^2.$$

In defining the criterion function of net returns to farmers, a cost of production must be deducted from gross returns. Let that cost be $C(q_t^s)$, which is assumed to reflect private opportunity costs of all factors used in milk production. Then the net return at year t is

$$\begin{aligned}(7)\quad & p_t^f q_t^f + c(q_t^s - q_t^f) - C(q_t^s) \\ &= x_t^1(a_o - a_1 x_t^1) + c[b_o + b_1 s_t^1 + b_2 c + b_3 s_t^2 - (a_o - a_1 x_t^1)] \\ &\quad - C(b_o + b_1 s_t^1 + b_2 c + b_3 s_t^2) = G(x_t, s_t).\end{aligned}$$

That completes all the necessary relations to put fluid milk pricing in the control model (1), at least within the context of this illustrative example using discounted private net returns to producers as the objective function.

Criterion Functions

Probably the most challenging aspect of using control theory for policy decisions is choosing an appropriate and meaningful criterion function. Obviously, net returns to farmers, such as that employed in the above example, is unsatisfactory since value to consumers is completely ignored. Net market values might be useful if additional constraints were imposed on the model which gave some consideration to consumer interests, For example, prices might be limited to an arbitrary rate of increase, or quantity produced could be kept above some lower limit. In the case of very inelastic demand, a lower limit on quantity would appear promising.

Nevertheless, a more fruitful approach would seem to be in the direction of using social value measures directly in the criterion function and imposing ancillary constraints to protect farmers' income position, but measurement of social value is a nebulous task, to say the least. In spite of the criticisms that have been waged against it, net area above the supply curve and under the demand curve, and its generalization by Hotelling [9] to a line integral for multiple commodities, looks the most promising as a social value measure. The above described area assumes an orientation with price the dependent and quantity the independent variable. From an operational point of view, the critical question is whether marginal utility of money can be taken as approximately constant on the region of variation in prices and quantities in an empirical analysis.

Looking at the demand side first, we have a technical requirement on the system of demand equations that must be met before a line integral can yield an unambiguous measure. Meeting this technical condition, which is the restricted integrability conditions, does not guarantee that marginal utility of money can be taken as constant. The problem can be analyzed with the aid of Slutsky's equation expressed in elasticities [6, p. 180],

$$\alpha_i e_{ik} - \alpha_k e_{ki} = \alpha_i \alpha_k (E_i - E_k), \tag{8}$$

where α_j and E_j are the budget proportion and income elasticity, respectively, for commodity j, and e_{ik} is the price elasticity of commodity i with respect to price k.

It follows directly from (8) that if the income elasticities are equal for commodities i and k,

$$\alpha_i e_{ik} = \alpha_k e_{ki}, \tag{9}$$

and (9) implies

$$\frac{\partial q_i}{\partial p_k} = \frac{\partial q_k}{\partial p_i} \tag{10}$$

which is the restricted integrability condition on the pair of demand functions. For obvious reasons, relation (10) will be referred to as the symmetry condition. Equality of income elasticities is a very restrictive assumption, but it can be relaxed by noting that if the budget proportions are small and the difference in income elasticities is in the same order of magnitude as (or smaller than) the cross price elasticities, than (9) and (10) hold approximately. This latter proposition will be recognized as a generalization of a theorem presented by Wold [19, p. 112]. The crux of the proposition is that direct substitution effects dominate the differential income effects for the pair of commodities.

If a set of agricultural commodities is closely interrelated in demand, we would expect the income elasticities to be similar (with some exceptions, of course), and equation (10) would be approximately met if the budget proportions were small. On the other hand, those commodities that are not closely related can probably be treated independently without too much error. The obvious difficulty of dealing with anything approaching an inferior good stems from the budget proportion being large. The limited statistical analysis that has focused on the symmetry condition does not refute it [15, p. 642; 4, p. 14].

We can probably justify the symmetry condition for a system of demand equations as an approximation. However, we have not avoided the issue of the constancy of the marginal utility of money merely by the symmetry condition. If symmetry is plausible primarily from equal income elasticities, we have only permitted treatment of the group of commodities essentially as a single commodity. Small budget proportions and relatively small variations on prices and quantities in the region of measurement are the only basis for assuming marginal utility of money approximately constant.

If for no other reason than practical necessity, empirical estimation of social value will probably be attempted by using the demand curve of the "representative consumer" (per capita demand equation) and associated values weighted by population to get total value. Variation in personal income is a source of possibly large differences in marginal utility of money among consumers but the estimated per capita demand equation will contain income as a concomitant variable. Therefore, per capita social value can be computed from the demand equation with median income, or some other measure of central tendency, substituted into the equation and that value multiplied by population to get total value. An alternative that is more consistent with market valuation (but which I feel is inferior as a social value measure) is to stratify the population with respect to income, compute a per capita social value for each stratum, and form a weighted sum of these values using population in each stratum as weights.

Theoretical treatment of supply has been rather limited, but Hotelling's early work showed the symmetry condition is met for supply equations generated by optimizing firms without money capital limitations [8]. These results suggest that the symmetry condition is probably met approximately in an agricultural industry dominated by commercial farms, as opposed to subsistence farming.

Another problem of measurement arises in regard to distributed lag demand and supply equations. Use of area under demand and above supply equations as a measure of social value is predicated on the assumption that these are the classical, static relations of abstract theory. Therefore, distributed lag equations should be unscrambled from their empirical basis as much as possible and transformed into a long-run static concept.

As an example, take the simple fitted equation

$$y_t = a + bp_{t-1} + cy_{t-1}$$

which has as its theoretical basis

$$(12) \qquad y_t = a' + b[p_{t-1} + \lambda p_{t-2} + \lambda^2 p_{t-3} + \cdots], \qquad |\lambda| < 1,$$

and the coefficients of (11) and (12) are related by $a = a'(1-\lambda)$, $c = \lambda$. One might be tempted to use (11) directly to get a measure of value, and treat y_{t-1} as a state variable that enters in a dynamic way by shifting the curve, but the value measure would be derived from a conditioned short-run function and not the long-run curve of static theory. Therefore, we must go to (12) which has its difficulties arising from an infinite series of lagged prices. How can an integral of value be deduced from such an equation?

Equation (12) can be written with a single price by defining a weighted average price, using the linear coefficients as weights,

$$(13) \qquad z_{t-1} = \sum_{j=1}^{\infty} b\lambda^{j-1} p_{t-j} \Big/ \sum_{j=1}^{\infty} b\lambda^{j-1},$$

and taking the sum of the coefficients as the linear coefficient on the new price variable. Thus, we have

$$y_t = a' + b' z_{t-1}$$

where

$$b' = \sum_{j=1}^{\infty} b\lambda^{j-1}. \tag{14}$$

The coefficient b' will be recognized as that used in distributed lag analysis to derive long-run elasticities. The correct measure of social value (cost) is an integral associated with equation (14).

Using properties of geometric progressions, (13) reduces to

$$z_{t-1} = (1 - \lambda) \sum_{j=1}^{\infty} \lambda^{j-1} p_{t-j} \tag{15}$$

and $b' = b/(1-\lambda)$. Relation (15) is the source of a *single* state variable to "carry along" all the information needed about previous prices, and the first order difference equation

$$z_t = (1 - \lambda) p_t + \lambda z_{t-1} \tag{16}$$

is the recurrence relation needed in model (1).

In general, a weighted average of lagged prices can be used as a single price in linear distributed lag equations, and the reduced equation in this single price variable is the source of an appropriate social value (cost) measure. However, more than one state variable will be necessary to specify the state of the decision process unless the lags are assumed to follow a convenient pattern, such as geometrically dampened effects that produced (16). Imposition of the symmetry constraint on a system of lagged equations will require the constraint to fall on the "long-run" relations; thus, in linear relations, certain pairs of sums of linear coefficients will be forced to have equal members.

Going back to the dairy pricing example and using a net social value criterion instead of market net returns, we need to transform the lagged supply equation into its long-run counterpart. Iterating (2) in the variable q_t^s and assuming $|b_3| < 1$,

$$\begin{aligned} q_t^s = b_0/(1 - b_3) &+ b_1(p_{t-1}^f + b_3 p_{t-2}^f + b_3^2 p_{t-3}^f + \cdots) \\ &+ b_2(p_{t-1}^m + b_3 p_{t-2}^m + b_3^2 p_{t-3}^m + \cdots), \end{aligned}$$

which is the supply equation expressed with a distributed lag coefficient on price that diminishes geometrically by the factor b_3. The long-run equation in weighted prices is

$$q_t^s = b_0' + b_1' z_{t-1}^f + b_2' z_{t-1}^m, \tag{17}$$

where $\quad b_j' = b_j/(1 - b_3), \qquad j = 0, 1, 2,$

and

$$z_{t-1}{}^{k} = (1 - b_3) \sum_{i=1}^{\infty} b_3{}^{i-1} p_{t-1}{}^{k}, \qquad k = f, m. \tag{18}$$

However, the manufacturing milk demand expressed by (4) lets us simplify (17) to

$$q_t{}^{s} = b_0'' + b_1' z_{t-1}{}^{f}, \tag{19}$$

where $b_0'' = b_0' + b_2'c$.

We again use $x_t{}^1 = p_t{}^f$ as the control variable, but now there is only one state variable, $s_t{}^1 = z_{t-1}{}^f$, and the state variable difference equation is

$$s_{t+1}{}^1 = (1 - b_3) x_t{}^1 + b_3 s_t{}^1. \tag{20}$$

The control variable, $p_t{}^f$, does not affect social costs in period t, but instead affects cost in period $t+1$ and all subsequent periods. However, the influence of $p_t{}^f$ in period $t+1$ and later is taken into account by the state variable.

Let us write the inverse of (3), with price as the dependent variable, as

$$p_t{}^f = D(q_t{}^s), \tag{21}$$

and the inverse of (19) is defined

$$s_t{}^1 = S(q_t{}^f). \tag{22}$$

Quantity supplied in period t is given by (19) which is abbreviated $\phi(s_t{}^1)$; likewise, let (3) be $\psi(x_t{}^1)$. The control variable, $x_t{}^1 = p_t{}^f$, is restricted to values greater than or equal to the price that would equate total quantity supplied with that demanded in the fluid market. Price in the fluid market cannot drop below this level because price would not ration the limited supply, but as long as price exceeds this level, excess supply (for the fluid market) is sold in the manufacturing market. This minimal price is given by solution of

$$\psi(x_t{}^1) = \phi(s_t{}^1) \tag{23}$$

in the variable $x_t{}^1$ which makes the minimal price a function of the state variable, $s_t{}^1$.

If the supply equation, $S(q)$, intersects the quantity axis at a positive quantity, that point is denoted q_o. For that situation, the criterion function is

$$G(x_t, s_t) = \int_0^{q_o} D(q)dq + \int_{q_o}^{\psi(x_t^1)} [D(q) - S(q)]dq + \int_{\psi(x_t 1)}^{\psi(s_t 1)} [c - S(q)]dq; \tag{24}$$

otherwise the first two integrals condense to the second with the lower limit changed to zero. Should the demand function for manufacturing milk be more complicated than (4), an additional state variable is required, but the criterion function is essentially the same. It is important to realize that the absolute level of the criterion function in (24) has no meaning; but it is a useful means to evaluate pricing policies that involve variations in prices and quantities within the region of experienced price-quantity relations. Implementation of policies that move prices and quantities outside this region should be gradual so that the information on demand and supply relationships generated by the changes can be fed back, through estimation, into the model.

Adaptive Models and Numerical Solution

Comprehensive decision models for policy will require systems of demand and supply equations for several commodities. The burden of statistical estimation may appear formidable, but the state of the arts in econometrics is ready for it. The greatest obstacle is one of organizing and soliciting the talent required for a sufficiently long period of time.

An operational model for policy purposes must be modified each year as additional information unfolds which means that a team of econometricians must be continually checking, testing, and reformulating the model. Some automated adaptive features can be implemented, such as in engineering adaptive control processes [2] or automatic statistical updating [1], but an economic decision model of this nature will probably require a good deal of subjective adaptation. The model should be formulated to permit maximum adjustment, and should incorporate all sources of information that look promising and are quantifiable.

There will be an interaction between the control model itself and the estimated relationships used within the model over time. To illustrate this point, let us look at supply estimation when the control model uses acreage allotments as a control variable in contrast to setting prices paid to farmers without allotments. The acreage allotments make statistical estimation of supply as a meaningful measure of social cost more difficult because net effects of price are confounded with the influence of allotments. Such relationships between choice of control variables and ability to estimate required empirical measures should be given serious consideration in developing control models for agriculture, assuming, of course, that the models might be used.

There are several alternatives for getting solutions to the optimization problem of (1), and experience thus far does not provide a good basis for choice among them. A direct approach is to use nonlinear programming to solve (1), which is the method proposed by Rosen [14]. A difficulty here is that computer capacity is easily exhausted if the number of state and control variables is large and a long time horizon is used. One way to cope with computer capacity is to divide the time horizon into several segments; then solve the short time horizon problem associated with the *last* segment for many initial state vectors s_o, and fit a suitable function to the optimized criterion function with s_o as a vector of independent variables. Let the fitted relation be $h_o(s_o)$. Then $h_o(s_o)$ is used as the *terminal* value of a second problem associated with the next to the last segment of the planning horizon which is solved by nonlinear programming for many initial state vectors s_0, and the fitted relation to that set of solutions is $h_1(s_o)$. The iterative process is repeated until a solution is achieved for the first segment of the planning horizon. Actually, the above described procedure is an application of dynamic programming to a sequence of nonlinear programming problems that have been parameterized in the state vector. The method looks promising for linear demand and supply equations coupled with linear difference equations since this specification would make (1) a quadratic program. Parametric methods in quadratic programming are relatively simple and the algorithms quite efficient.

Another approach is Wilson's [18], using the method of conjugate gradients. It also is especially appealing for quadratic criterion functions since convergence is known to be rapid in that case. Wilson's method contains a decomposition principle that partitions the problem in the time dimension which is advantageous for limited computer capacity.

Dynamic programming can be applied directly to the problem; the functional equation associated with (1) is

$$v_n(s) = \operatorname*{Max}_{x}\,[G(x, s) + \beta v_{n-1}(s + f(x, s))], \qquad x \in R(s). \tag{25}$$

Numerical solution of the functional equation in (25) has its difficulties when s is a vector of more than two or three components. Bellman has suggested possible means of overcoming this difficulty, but analysts have not experimented in this direction very much [2, p. 244]. One advantage of dynamic programming is that stochastic features can be incorporated with less difficulty than under alternative methods.

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Discussion: The Potential Role of Control Theory

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IN ECONOMICS, control theory is rapidly becoming one of the fundamental tools of analysis. This development would be expected, of course, since this theory represents a dynamic method of constrained optimization.

In particular, control theory is ideally suited to the study of programming problems over time; and, in this context, economists are deriving computable Fisherian formulas [1] for the firm's investment, inventory, and money demands (*cf.* [4]).

Here today, both Tintner and Burt have presented some macro applications of these methods. The AAEA audience will surely find them interesting. Their approach represents a fitting introduction. In fact, it is so fitting that I decided to deviate from normal procedures, and present a micro example to further illuminate the potential of these methods.

This example will be a stochastic production-inventory model for irrigated farming where the water source is an irreplenishible underground aquifer. It will be developed as a discrete-time optimal control problem using a method by Thompson *et al.* [5].

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Initially, some definitions and assumptions will be introduced; and a production-inventory model where the rainfall is regarded as known—Problem I—will be specified. The rainfall will next be regarded as not being known precisely, but having a known probability distribution. *It will further be visualized that plans must be made regardless of this randomness; and the farmer must optimally determine the amount of rainfall to plan for.* Another control variable is introduced; and penalties for under- and over-anticipated rainfall are assigned. The added variable is included as a constraint; and the expected values of the penalties are included in the objective function. This transformed problem—Problem II—is deterministic in form, and may be analyzed by received methods.

The Formulation

Definitions[1]

w_t is water pumped; v_t is the rainfall planned for. These are the unknown controls, $t=1, 2, \cdots, T$.

x_t is water in the underground aquifer; y_t is soil moisture in inventory. These are the unknown states, $t=1, 2, \cdots, T$.

α_t is per unit net returns excluding pumping costs; f_t is production; g_t is pumping costs; γ_t and ζ_t are increases in soil moisture due to rainfall and irrigation, respectively; ξ_t is the decrease in soil moisture resulting from transpiration, evaporation, and percolation; τ_0 is pumping capacity; δ_t is the discount rate; and $\phi_t = 1/(1+\delta_t)^t$ is the discount function. These functions are regarded as known, $t=1, 2, \cdots, T$.

r_t is rainfall. It is regarded as known in Problem I, and as a random variable having a known probability distribution, $F_t(r_t)$, in Problem II, $t=1, 2, \cdots, T$.

Assumptions

f_t and $-g_t$ are strictly concave in their respective arguments; r_t is nonnegative; and $F_t(r_t)$ is aboslutely continuous with density $f_t(r_t) \neq 0$, $t=1, 2, \cdots, T$.

$\alpha_t, \gamma_t, \xi_t, \delta_t, \zeta_t$, and τ_o are positive; $f_t, g_t, \partial f_t/\partial y_t$, and $-\partial g_t/\partial x_t$ are positive for all feasible values of their respective arguments with $f_t(0)=0$ and $g_t(0^+)=+\infty$, $t=1, 2, \cdots, T$.

Problem I, where r_t is regarded as known

Maximize

$$I = \sum_{t=1}^{T} \phi_t\{\alpha_t f_t(\xi_t y_t) - g_t(x_t)\}$$

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[1] The subscript "*t*" means in period *t*.

subject to the difference equations

(I.1) $x_t - x_{t-1} = -w_t$, x_0 given and positive,

(I.2) $y_t - y_{t-1} = \gamma_t r_t + \zeta_t w_t - \xi_t y_t$, y_0 given and positive, and subject to the inequalities

(I.3) $0 \leq w_t \leq \tau_0$, where $t = 1, 2, \cdots, T$.

As mentioned above, we will next visualize r_t as not being known exactly, but having a known probability distribution, $F_t(r_t)$. Moreover, plans must be made regardless of this randomness. Let $v_t = (y_t - y_{t-1} - \zeta_t w_t + \xi_t y_t)/\gamma_t$; and let $(r_t - v_t)^+ = r_t - v_t$ if $r_t - v_t \geq 0$ and zero othrewise, $(r_t - v_t)^- = v_t - r_t$ if $v_t - r_t > 0$ and zero otherwise. Also let $m_t(r_t - v_t)^+$ be the penalty for under-anticipated rainfall, and $m_t(r_t - v_t)^-$ be the penalty for over-anticipated rainfall. Then let

$$H_t(v_t) = E[m_t(r_t - v_t)^+ + m_t(r_t - v_t)^-],$$

or

$$H_t(v_t) = \int_{vt}^{\infty} m_t(r_t - v_t)^+ dF_t(r_t) + \int_0^{v_t} m_t(r_t - v_t)^- dF_t(r_t).$$

$H_t(v_t)$ will be regarded as convex in v_t. (Sufficient mathematical requirements for the convexity of H_t in v_t are straightforward, but will not be made here in the interest of brevity.) To further simplify, difference equation (I.1) will be solved for x_t; and the solution will be substituted into g_t.

Problem II, where r_t is visualized as random[2]

Maximize

$$I = \sum_{t=0}^{T} \phi_t \left\{ \alpha_t f_t(\xi_t y_t) - g_t\left(x_0 - \sum_{i=1}^{t} w_i\right) - H_t(v_t) \right\}$$

subject to the difference equations

(II.1) $y_t - y_{t-1} = \gamma_t v_t + \zeta_t w_t - \xi_t y_t$, y_0 known and positive, and subject to the inequalities

(II. 2) $0 \leq w_t \leq \tau_0$, (II.3) $0 \leq v_t$, where $t = 1, 2, \cdots, T$.

Problem II is a deterministic convex programming problem, linear in all the constraints. Thus, the requirements for Theorems 1, 2, and 3 by Kuhn and Tucker [3] are satisfied.

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[2] Note that Problem II may be extended to allow for the following possibilities: (1) a soil nutrient inventory, fertilizer supplementation, and interaction between soil nutrient and moisture use, (2) investments in farming and irrigation capacity, (3) cash flows, money costs, and money earnings, (4) income and property taxes, (5) standard input-output relations, and (6) stochastic prices [2].

The Lagrangian function for Problem II and associated preliminary results

$$L(v_t, w_t, y_t, p_t, \mu_t, \lambda_t, \theta_t, t = 1, 2, \cdots, T)$$

$$= \sum_{t=1}^{T} \phi_t \left\{ \alpha_t f_t(\xi_t y_t) - g_t\left(x_0 - \sum_{i=1}^{t} w_i \right) - H_t(v_t) \right\}$$

$$+ \sum_{t=1}^{T} p_t(y_{t-1} - y_t + \gamma_t v_t + \zeta_t w_t - \xi_t y_t)$$

$$- \sum_{t=1}^{T} \mu_t(w_t - \tau_0) + \sum_{t=1}^{T} \lambda_t w_t + \sum_{t=1}^{T} \theta_t v_t.$$

Let v_t^0, w_t^0, y_t^0, denote the optimal controls and states, $t = 1, 2, \cdots, T$. Then multipliers p_t^0, $\mu_t^0 \geq 0$, $\lambda_t^0 \geq 0$, $\theta_t^0 \geq 0$, $t = 1, 2, \cdots, T$, exist such that $\partial L^0/\partial v_t = 0$, $\partial L^0/\partial w_t = 0$, $\partial L^0/\partial y_t = 0$, $\mu_t^0(w_t^0 - \tau^0) = 0$, $\lambda_t^0 w_t^0 = 0$, $\theta_t^0 w_t^0 = 0$, $t = 1, 2, \cdots, T$, hold at the optimum (with (II.1), (II.2), and (II.3) also being satisfied).

Let $A_t(v_t) = p_t^0 \gamma_t - \phi_t \partial H_t(v)/\partial v_t$; and

$$B_t(w_t) = \phi_t \partial g_t\left(x_0 - \sum_{i=1}^{t-1} w_i^0 - w_t \right) / \partial w_t + p_t^0 \zeta_t.$$

It is easily shown[3] that A_t is strictly decreasing in v_t, B_t is strictly decreasing in w_t, and $A_t(v_t) = 0$ for some feasible v_t (when Problem II has a solution).

The Basic Decision-Making Rules

Theorem

(a) $B_t(0) < 0$ and $A_t(0) \leq 0$ implies $w_t^0 = 0 = v_t^0$; (b) $B_t(\tau_0) > 0$ and $A_t(0) \leq 0$ implies $w_t^0 = \tau_0$ and $v_t^0 = 0$; (c) $B_t(0) < 0$, $A_t(0) > 0$ but $A_t(v_t^*) = 0$ for some feasible v_t^* implies $w_t^0 = 0$ and $v_t^0 = v_t^*$; (d) $B_t(\tau^0) > 0$, $A_t(0) > 0$ but $A_t(v_t^*) = 0$ for some feasible v_t^* implies $w_t^0 = \tau_0$ and $v_t^0 = v_t^*$; (e) $B_t(0) \geq 0$, $B_t(\tau_0) \leq 0$, and $A_t(0) \leq 0$ implies $v_t^0 = 0$ and w_t^0 is the unique solution to $B_t(w_t) = 0$; and (f) $B_t(0) \geq 0$, $B_t(\tau_0) \leq 0$, $A_t(0) > 0$ but $A_t(v_t^*) = 0$ for some feasible v_t^* implies w_t^0 is the unique solution to $B_t(w_t) = 0$ and $v_t^0 = v_t^*$. These results hold for $t = 1, 2, \cdots, T$. (See Thompson *et al.* [5] for proof, and note solutions can be computed by convex programming algorithms.)

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Discussion: The Potential Role of Control Theory

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To some Congressmen, and to some businessmen, "controls" is a dirty word. To them, controls are elaborate and detailed regulations of all industries by a bunch of impractical, longhaired bureaucrats who never won an election or met a payroll.

I take it that this is not what my good friend, Gerhard Tintner, means by "control variables." Nor what the officers of the Association meant by arranging a session on "control theory." Any nation's economy is subject to all sorts of controls. Some are Government regulations. Some are policies and practices of industry. Some are institutional arrangements, habits, and customs. Some are the controls of a free market.

Few, if any, economists would advocate controls for the sake of controls. But some kinds and degrees of controls are essential—whether by Government or not. No one really wants anarchy. The goals of society can best be determined by the people, preferably through an elected Congress. The technically qualified economist can be most helpful by indicating what policies are needed to reach whatever goals are set by the people.

Both Tintner and Burt have presented useful theoretical models. Such models can help us understand basic principles. But I am sure Tintner and Burt would agree that pure mathematics alone will not give us good economic policies. First, we need adequate, reliable statistics to make our models realistic. Second, the economist, the mathematician, and the statistician must work with competent men in other disciplines: the physical scientist, the sociologist, the historian, the political scientist, and others.

Some of us like to dream about the possibility of automatic controls in economics. Such controls would be like the thermostat in my house. When the temperature falls below 70 degrees, the thermostat sends a message to the heater; the gas is turned off and the cycle repeats itself all day with-

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out any human attention. Perhaps some day we can operate our tax system in a similar manner. Instead of debating for two years whether to change our tax rate, perhaps we can decide to change it automatically when certain economic indexes reach predetermined levels. We already have a few such automatic controls. For example, wage rates are commonly adjusted automatically to reflect changes in the Consumer's Price Index. Perhaps in time other automatic controls will be found to be practicable, useful, and generally acceptable.

But I suspect it will be a long time before we are ready to rely upon any automatic mechanism to control our whole economy. I do not think the economist alone can ever define "net social value," nor do I believe that the "competitive equilibrium" would always be ideal, even if we knew how to accomplish it. For the next few centuries, at least, I think econometricians can contribute most by helping to work out a very few controls in limited areas. Both Tintner and Burt discuss agricultural controls. We have had some experience with such controls. Not all of this experience has been completely satisfactory. The econometrician should be able to improve this situation. He could help develop a better formula for "parity prices," or a more intelligent program of reserve stocks. He could help to relieve the desperate situation in India by finding out how to increase agricultural output. For such purposes, he needs not only a theoretical model; he needs reliable statistics, competently analyzed and interpreted.

This, in my opinion, is the weakness of 95 percent of the so-called "econometric" literature: it *should* combine theory, mathematics, and statistical analysis. But too often it is only some fancy mathematics, with trivial attention (if any) to the practical problems of statistical analysis. The best book I know of on econometrics is the one by Tintner [1]. It covers a variety of techniques and shows how to apply them to practical statistical problems. We need more applied research on economic controls.

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TECHNOLOGY, DEMOGRAPHY, AND U.S. RURAL ECONOMIC POLICY

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Demographic and Social Considerations for U.S. Rural Economic Policy

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IF A demographer has anything worth saying, he welcomes the chance to expose others to the approach of his field and the implications of his insights. But this joy is tempered when he is asked to do so in years ending in 8, or even 7 or 6. For, although his wisdom may abound in the early years of a decade, much of it has become commonplace or clouded with uncertainty near the end of the decennial period. This is particularly true when the subject considered is the rural population, for, as officially defined, it can be measured only in a full census and cannot be acceptably approximated in intercensal sample surveys. However, if an opportunity for such a presentation does not come in a year ending in 2 or 3 or 4, one does the best one can in a year ending in 8.

There are some facets of the rural demographic picture that it is unnecessary to demonstrate. Everyone knows that with the decline in farm employment the farm population has dropped rapidly. We have all heard that the rural population is a smaller proportion of the total population than formerly. And, for that matter, it is now reasonably common knowledge that the majority of rural people no longer live on farms or work directly in farming. Each of these facts has clearly affected the thinking of policy makers, in the last decade particularly. There are other demographic conditions, however, that are not as clear cut or as well understood either in their trends or their implications. I should like to focus on several such features that I regard as significant and in need of explication.

One recurring problem in furnishing information about rural areas is the inevitable and understandable desire of policy makers to have generalizations and brevity. Yet, in the case of rural areas, national generalizations can often be misleading and potentially harmful. If there is one point about American rural demography that needs emphasis, it is that there are widely divergent demographic conditions in the rural population associated with different geographic regions and ethno-cultural

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groups. This is true of population growth trends, migration patterns, fertility, age structure, and changes in small towns.

Fertility

The discussion can begin with fertility, for the typically higher rural than urban fertility has always been a factor underlying the age structure of the rural population and fostering outmigration. In 1960 the cumulative fertility of women nearing the end of the childbearing period (35–44 years) was about 28 percent higher in rural areas than in urban.[1] The potential for population increase was at least 250 percent greater per generation among rural women than urban, however, for only that proportion of childbearing above generational replacement needs goes to increase the population. Rural women averaged about 950 to 1,000 children per 1,000 women above replacement needs, whereas urban women averaged only 250 to 300 per 1,000 above the replacement requirement.[2] Thus, although urban women 35 to 44 years numbered more than 70 percent of all U.S. women of that age, they contributed little more than 40 percent of the childbearing involved in growth of the national population.

More important to our discussion is the fact that there is more variation in fertility among rural people than urban. Particularly, there are many more areas and population groups of high fertility among rural people. Figure 1 illustrates the distribution of high fertility populations in the United States. Four or more children ever born per ever married woman aged 35 to 44 years (in 1960) is the index of high fertility used. Under current mortality rates, populations of this fertility double themselves—or more—in a generation, a period of about 25 to 27 years. It is immediately noticeable from the map that metropolitan counties are conspicuously absent (there are only two, of Mexican-American population), nor is there any meaningful representation from the entire Northeast, the Lower Great Lakes Region, the Corn Belt, the southern Wheat Belt, and the Pacific States. These areas simply do not have abnormally high growth potential from either their rural or urban populations.

In almost all cases the high fertility level is associated with a comparatively distinctive ethnic or subcultural population. With the exception of metropolitan areas, most of the entire span of the Southern Coastal Plain is represented for the Negro population, from Southern Maryland to East Texas. The high average Negro fertility in this region is the product of the rural population; southern urban Negro women average only 3 children

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[1] In the United States as a whole, the number of children ever born per 1,000 women ever married, 35–44 years old, was 3,127 for rural women and 2,436 for urban women [8, p. 1–212].

[2] Assuming a requirement for generational population replacement of about 2,150–2,200 children ever born per 1,000 women ever married, 35–44 years old.

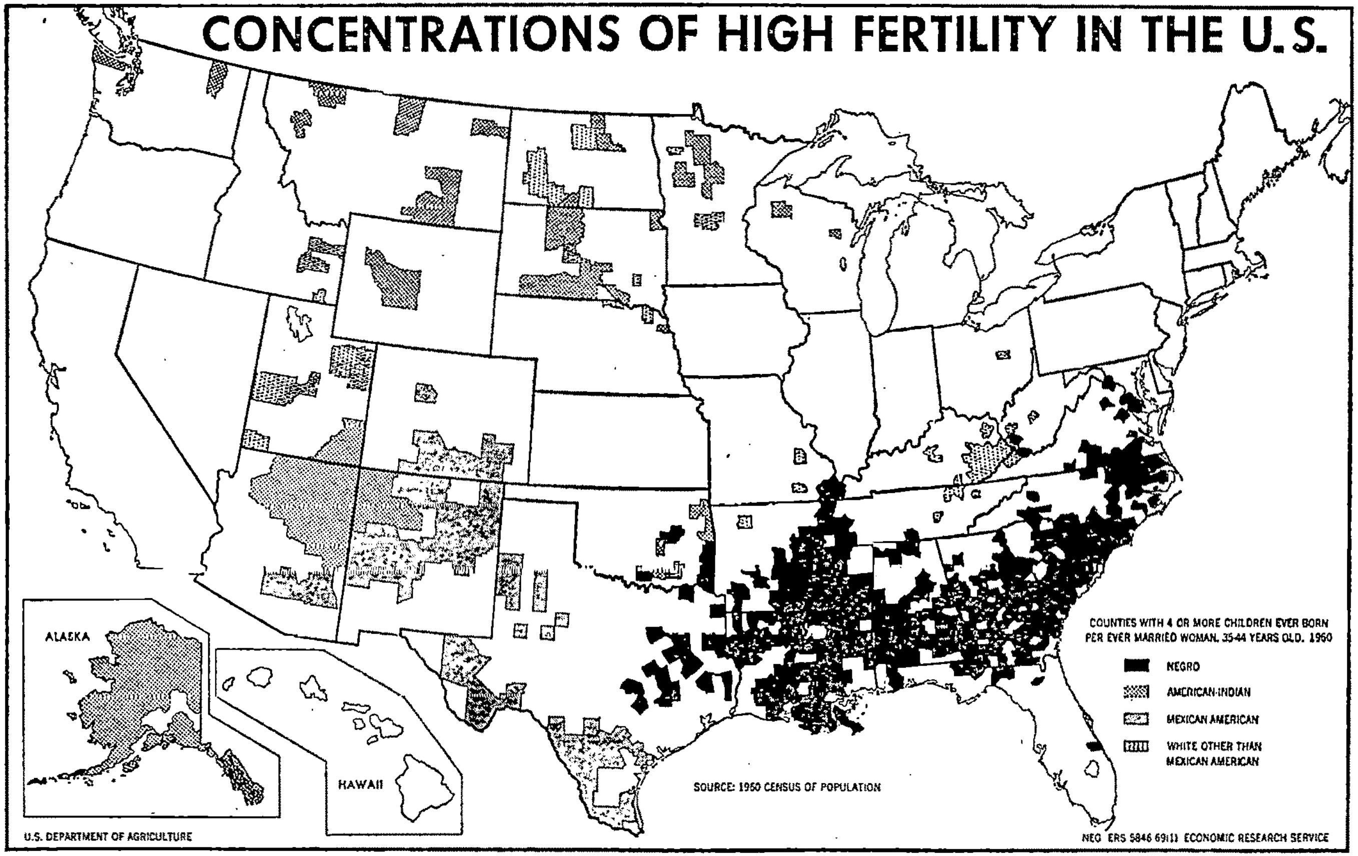

CONCENTRATIONS OF HIGH FERTILITY IN THE U.S.
COUNTIES WITH 4 OR MORE CHILDREN EVER BORN PER EVER MARRIED WOMAN, 35-44 YEARS OLD, 1960
NEGRO
AMERICAN INDIAN
MEXICAN AMERICAN
WHITE OTHER THAN MEXICAN AMERICAN
ALASKA
HAWAII
SOURCE: 1960 CENSUS OF POPULATION
U.S. DEPARTMENT OF AGRICULTURE
NEG ERS 5846 69(1) ECONOMIC RESEARCH SERVICE

Figure 1.

per woman. Although 4 or more children per woman has been used as the measure of high fertility, the Negro rural population averaged better than 4.5 children per woman. Furthermore, Negro rural fertility increased during the 1950's. In only one of the counties of high Negro fertility did the white women average 4 or more children.

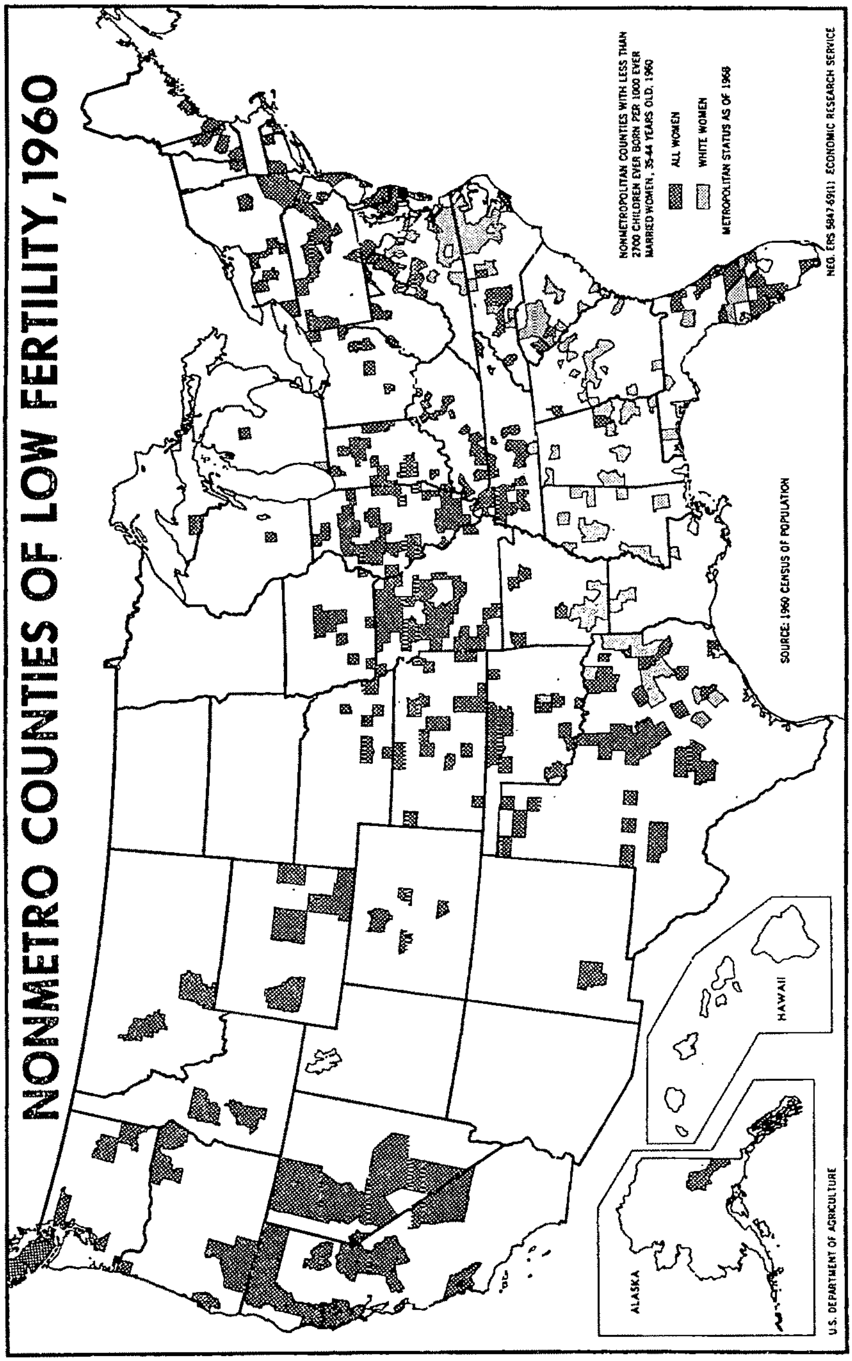
In the Southwest are sizeable areas in which the Mexican-American population has high average fertility and accounts for a significant fraction of the entire population. The average level of rural Mexican-American childbearing is nearly 5 children per woman.

Other areas on the map are those in which the white population—other than Mexican-American in the Southwest—averages 4 or more children per woman. There are no large concentrations of such areas. The most populous is the Coal Fields Area in the heart of the Southern Appalachians. Similar in character to one another but not always contiguous, are small predominantly Mormon areas of Utah and Idaho, and a scattering of counties in the Northern Plains that are usually of German Catholic population.

In addition, there are areas in which American Indians or Alaskan natives comprise 10 or more percent of the population and have high fertility. Alaska and the Four Corners area of the Southwest are the most important concentrations. The average is fully 5 children per woman.

This map, then, identifies the groups, together with their locations, whose fertility is exceptionally high by modern standards, leading to high continued potential growth. They are preponderantly rural and, with the exception of the Mormon and German Catholic groups, are characterized by widespread poverty, low educational attainment, and high social visibility. With the same exceptions, they are the very groups whose urban migration gives most concern to cities—indeed, they may be the only groups whose migration troubles urban interests—and they comprised the four rural elements who were represented in the Poor Peoples Campaign to Washington in 1968. Judging from the limited attitudinal data available, many of the families in these groups are bearing more children than they want, even though their desired family size is higher than the national average.

At the other extreme are rural areas of low fertility. Low fertility in this nation since the recovery of the war and postwar years rarely means low to the point of being insufficient for generational replacement. Rather, it is fertility sufficient to increase each generation by a modest increment, say by no more than 25 percent, or less than 1 percent annually. An average of 2,700 children per 1,000 ever married women 35 to 44 years old will do this under conditions of low child mortality and high incidence of marriage. Figure 2 shows the nonmetropolitan countries of the United States in which fertility was less than 2,700 children per 1,000 women in 1960.



NONMETRO COUNTIES OF LOW FERTILITY, 1960

NONMETROPOLITAN COUNTIES WITH LESS THAN 2700 CHILDREN EVER BORN PER 1000 EVER MARRIED WOMEN, 35-44 YEARS OLD, 1960
▨ ALL WOMEN
▨ WHITE WOMEN
METROPOLITAN STATUS AS OF 1968
HAWAII
ALASKA

SOURCE: 1960 CENSUS OF POPULATION

U.S. DEPARTMENT OF AGRICULTURE NEG. ERS 5847-69(1) ECONOMIC RESEARCH SERVICE

Figure 2.

Because many metropolitan counties have low fertility, the map has been restricted to nonmetropolitan counties in order to focus on the occurrence of such fertility levels in essentially rural areas. In addition, the map shows those counties in which the white population has less than 2,700 children per 1,000 women even though the overall county average was higher.

The geographic pattern of low fertility is not very blockish, but shows strong representation in the nonmetropolitan parts of the Northeast, central and southern parts of the Corn Belt, the lower Ohio Valley, and the Far West. Unlike the areas of high fertility, it is difficult to characterize the low fertility areas culturally. They are primarily Protestant, other than Lutheran, and include a fair number of future metropolitan counties. Agriculturally they largely exclude the farm areas that were last to be settled or that were not primarily settled by people of colonial stock.

In the South, there is a sizeable group of counties in the North Carolina-Virginia Peanut Belt and some adjoining tobacco counties in which the white number of children ever born per woman is low. I have no suggestion as to why. There is also considerable representation of low white fertility areas in the industrialized Southern Piedmont, the Alabama-Mississippi Black Prairie and in the old cotton area of East Texas. Central Florida is a zone of low total and white fertility.

Although the background of the pattern of low fertility in the areas shown is obscure, the economic significance for each of the areas is that they are under only minimal pressure from the force of childbearing (or, in the South, from white childbearing) for expansion of facilities, services, and employment.

The remaining predominantly rural areas of the country have intermediate cohort levels of fertility that provide substantial population growth or migration potential, but not to the point of resembling conditions in underdeveloped nations.

Migration

On the subject of migration, I should like to discuss three matters—the effects of migration on age structure, the pattern of migration from rural areas since 1960, and a current misunderstanding of the relation of gross migration to net migration.

In rural areas, net migration is commonly the major component of population change. It is also a major determinant of age structure. Outmigration of youth, in particular, has been very high since the Depression. From 1950 to 1960, the rural and predominantly rural counties of the United States that had net outmigration lost 40 percent of their youth who reached 20 years of age during the decade.[3] In some areas, such as the Southern Coal Fields the loss reached 50 percent; and in the poorest southern counties, exceeded 60 percent for Negroes of this age. Such rates of outmovement among the young serve to raise the average age of the remaining population and the proportion of older people, *unless* offset by high fertility among persons remaining and by comparatively rapid outmovement of middle-aged people. Because some rural areas of high outmigration had high fertility and others had relatively low fertility, and because the patterns of middle-aged migration varied by area for a given level of youth outmigration, the overall effect of outmigration on age structure has been quite variable. The popular conception that rural areas were left with hardly anyone except older people after the major exodus from farming and coal mining is all too well approximated in some areas, but is quite erroneous for others. Let me illustrate.

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[3] Data on net migration 1950–60 by age and color are available in [1].

In the Southern Appalachian Coal Fields the net outmigration rate of youth 20 to 24 years old in 1960 was one third higher than that of white youth in all Southern rural counties of net outmigration, but the Appalachian rate among persons in their 50's was double that of all Southern white persons of the same age (see Table 1). The same differences were evident between whites and nonwhites in rural Southern outmigration counties. For persons aged 20 to 24 in 1960 the outmigration rate during the prior decade for nonwhites was just 20 percent higher than that of whites, but for age 50–54 the nonwhite rate was double that of whites. These age comparisons would be even more extreme if the Southern nonwhite and Coal Fields patterns were compared with Midwestern rural rates.

Table 1. Selected net outmigration rates, 1950–60[a]

Age in 1960	Rural net outmigration counties of the South		Southern Appalachian coal fields (C)	Ratio of:	
	White population (A)	Nonwhite population (B)		B to A	C to A
Years	Percent				
15–19	−20.1	−25.5	−31.8	1.269	1.582
20–24	−41.5	−50.0	−55.4	1.205	1.335
25–29	−38.9	−54.9	−50.8	1.411	1.306
30–34	−22.3	−42.2	−35.5	1.892	1.592
35–39	−16.5	−30.0	−29.2	1.818	1.770
40–44	−12.1	−21.4	−23.7	1.769	1.959
45–49	−10.2	−18.3	−21.2	1.794	2.078
50–54	− 7.9	−16.4	−18.1	2.076	2.291
55–59	− 5.6	−16.0	−15.2	2.857	2.714

[a] Estimates of 1950–60 net migration expressed as a percentage of the population that would survive to 1970.

Source: [1] and unpublished tabulations from the same project.

Bearing in mind this point and the previous fertility discussion, note the wide variations in median age of the population in 1960 in the next map (Figure 3). Counties are shown in which the population had a median age of 35.0 years or older in 1960, or a median of less than 23.0 years. Practically all of the counties in both groups are nonmetropolitan. Few of them are even of a submetropolitan character. In other words, the occurrence of extreme age distributions—young or old—in this country is almost entirely a phenomenon of rural and small town areas.

From the Southern Corn Belt extending southward to the Hill Country of Central Texas is a roughly triangular-shaped area of about 300,000 square miles in which the majority of all nonmetropolitan counties, including several large contiguous blocks, have a median age above 35.0. The proportion of elderly people is anywhere from 2/3 to 100 percent higher than the national average. Young adults and young children are comparatively few in number. This is the end result of prolonged age-selective outmigration on a population of low to moderate fertility, here and there abetted by inmovement of older people for retirement while outmovement of the young continues. Elsewhere there are only minor groupings of high-age counties—in the Pennsylvania anthracite area, in relict metal mining counties of the West, in parts of the Upper Great Lakes Cutover area, and in Central Florida. In the latter area it results from inmigration of older people rather than outmovement of the young.

In strong contrast are the counties where average age was less than 23.0 years in 1960. Some of these areas are well known for high outmigration and as a result are misconceived as being of high average age. They include the heart of the Southern Coal Fields, much of the tobacco and cotton coastal plain of the Carolinas, and most of the Black Belt and the Mississippi Delta—in short the worst poverty areas of the South. High fertility and the unusual age structure of migration described earlier have shaped this pattern.[4] Except for the Appalachian group, most of these Southern areas have a median age below 23.0 years only because of the low average age of the Negro population. Indeed, the Negro medians are usually in the upper teens. West of the Mississippi is an area stretching from the Lower Rio Grande Valley to southeastern Idaho where the average age is low. Three different cultural groups are involved—the Mexican-Americans along the length of the Rio Grande, Indians in the Four Corners area, and the familistic but prosperous Mormon population of Utah and Idaho. Finally, the large but thinly settled Indian and Eskimo

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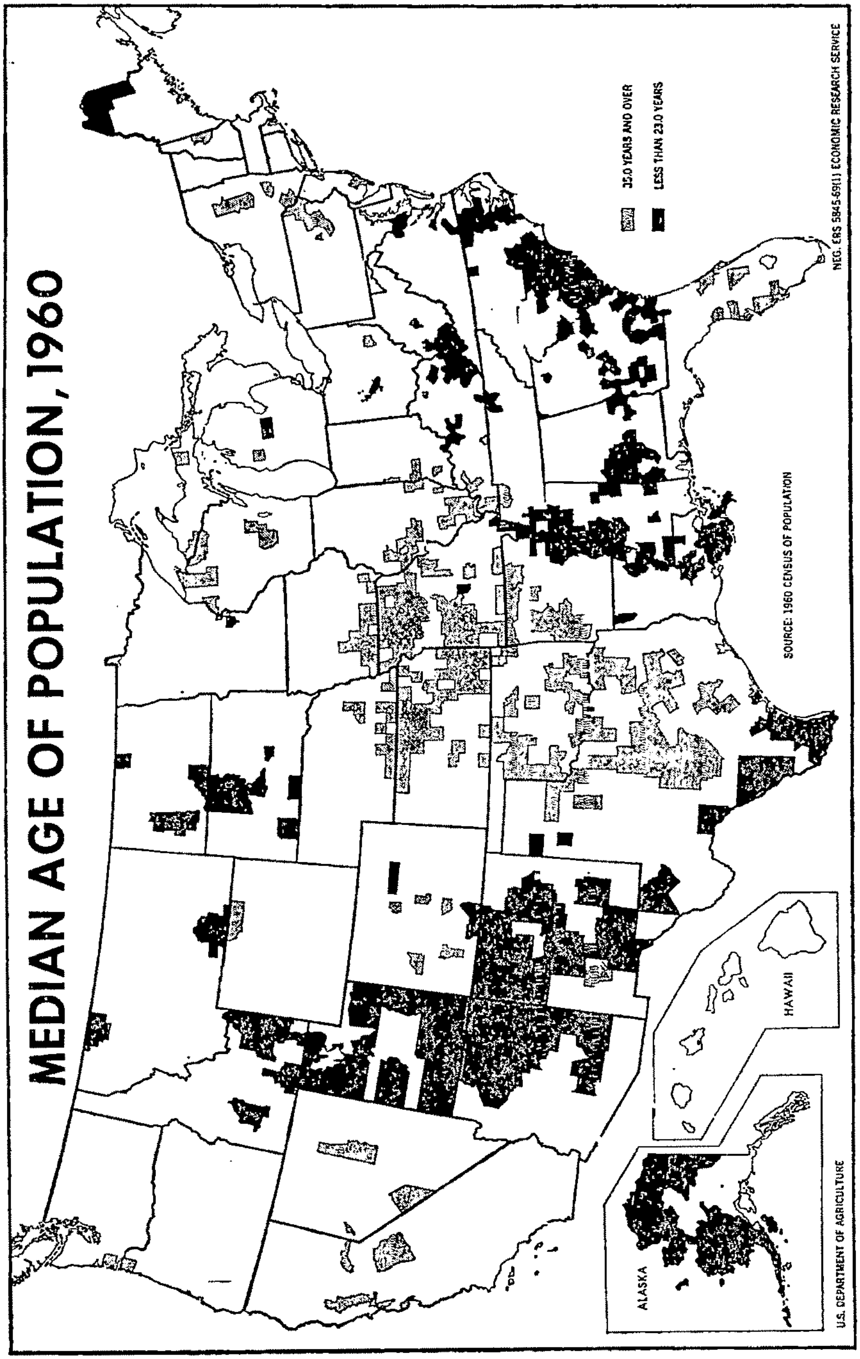
[4] Higher than average mortality among Negroes in earlier years would also have helped to produce low median ages in the past, but would not be a factor in the failure of the median age to rise in recent years. This same comment would apply to Mexican-Americans, Indians and Alaskan natives.



MEDIAN AGE OF POPULATION, 1960

SOURCE: 1960 CENSUS OF POPULATION

U.S. DEPARTMENT OF AGRICULTURE

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Figure 3.

areas of Alaska are exceptionally low in average age, as are some Indian and Catholic counties of the Northern Plains.

The economic development problems of the rural areas of very low or high average age would certainly seem to differ in important respects. The young-age areas with a high demographic growth potential require much higher rates of job growth if an objective of their development is the reduction of the necessity of migration. With the exception of the Mormon areas, they are short of skilled and educated people but have a heavy supply of new workers. The high-age areas, on the other hand, with their small families and crushed age structure, are comparatively short of labor force, both presently and potentially. Except for the Southeastern margin of the high-age area the educational level is good, but any significant development of job opportunities would almost certainly require the importation of workers. And each succeeding high school class in these areas is typically smaller than the previous one because of the steadily reduced number of births over the last two decades.

As a footnote on the areas of high average age, it should be realized that most of them either are now having more deaths than births, because of the distorted age structure, or are approaching such a condition. Thus, the population has come to decline from natural decrease as well as from outmigration, and the counties have a new stigma to overcome in promoting economic activity. There were over 300 natural decrease counties in 1966 and the number could rise to 600 by 1970. Nationally, an increase in births is expected by 1970 or thereafter because of growing numbers of young married couples, but the high-age rural areas will not be getting more such couples unless they can retain a far higher percentage of their young people at home than they are now doing.

In the future, it is probable that there will be more rural counties of high average age, and in some areas where they were not found in 1960. For example, from 1960 to 1966, births in nonmetropolitan areas of the Dakotas, Montana, and Minnesota dropped by about 28 percent, creating very rapid undercutting of the age structure in a heretofore rather young population of moderately high fertility.

Population and Migration Trends, 1960 to 1966

Because the Bureau of the Census has now made population estimates for all counties for 1966, we have some means of evaluating change in the population of rural areas since 1960.[5] Estimating population for local areas is less than a perfect science, but the general patterns shoud be valid.

In general, the evidence indicates that completely or primarily rural counties retained their potential population growth much better from 1960 to 1966 than they did in the 1950's. In the '50's the rural counties gained 3.3 million in population while also losing a net of 4.6 million migrants.[6] But from 1960 to 1966, they gained 2.8 million, while their outmigration was reduced to about 550,000, or only a fifth of the annual average loss of the 1950's. Because of lower natural increase, the growth potential of rural areas was less in the '60's, but the areas retained the equivalent of a much higher proportion of their growth potential than formerly. Whereas in the '50's rural counties in the country as a whole had about 150 outmigrants for every gain of 100 in population, since 1960 they have had only about 20 net outmigrants per 100 gain in population. This improvement has been expecially noticeable in the entirely rural counties and those with less than 30 percent urban population. All of the growth of population in rural areas in the 1950's was limited to the class of counties that were 30 to 50 percent urban, but this has not been so since 1960.

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[5] See [7].

The most dramatic regional shift has come in the East South Central states. These four states, embracing both Appalachian heartland areas and Deep South Delta and Black Belt areas, exported a net of 1.5 million migrants from their rural areas in the 1950's, but only 164,000 from 1960 to 1966. This is an appropriate place to make clear the point that despite the rise of public concern over rural-to-urban migration from the South in the mid-1960's, the force of the trend had been greatly reduced by the time public awareness developed.

The division that has done least well since 1960 in retaining population in rural areas is the West North Central States. These states contributed more rural net migration to other areas than any other part of the country in the 1960 to 1966 period—some 300,000 persons. By contrast, in the 1950's each of the three census divisions of the South had more rural outmigrants than did the West North Central Division. Even so the outflow from the West North Central states is reduced both in number and rate compared with the '50's.

To illustrate recent regional differences in population change more readily, a map has been prepared that divides the counties of the nation into three groups: (1) those that have grown in population from net inmigration, as well as from such excess of births over deaths as they may have, (2) those that increased in population but had some net outmigration to other areas, and (3) counties that declined in total population (Figure 4).

The growth rates of the counties having inmigration vary considerably, but given the close association of economic and population development, most of these areas can be said to have generated more employment in

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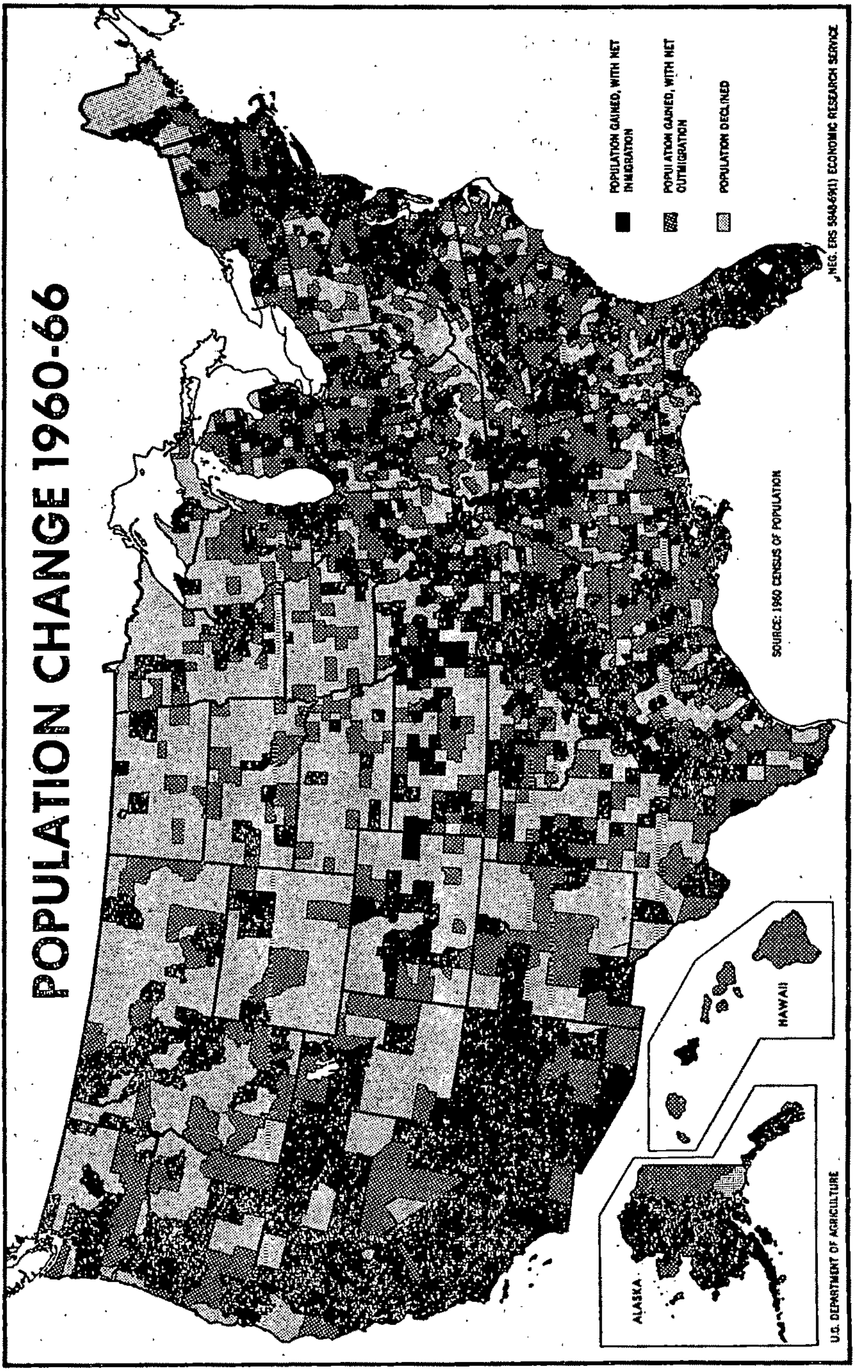
[6] This statistic should not be confused with the fact that the total United States rural population of 1960 was no larger than that of 1950. Some growing rural areas were reclassified as urban in 1960 as a result of annexation to cities or increase in community size.


POPULATION CHANGE 1960-66
■ POPULATION GAINED, WITH NET INMIGRATION
▨ POPULATION GAINED, WITH NET OUTMIGRATION
▒ POPULATION DECLINED
ALASKA
HAWAII
U.S. DEPARTMENT OF AGRICULTURE
NEG. ERS 5848-69(1) ECONOMIC RESEARCH SERVICE

SOURCE: 1960 CENSUS OF POPULATION

Figure 4.

recent years than the local labor force could handle. Much of the Atlantic Metropolitan Belt is evident in this respect, and there are many growth counties in the Southern Piedmont and the Middle Tennessee Valley. West of the Mississippi there are a surprising number of inmigrant counties in eastern Oklahoma and northern and western Arkansas, where very heavy loss of population was the norm in the 1950's. Some of the growth here is connected with retirement and recreation developments, and some with the very real progress in industrial employment that has come to this part of the country. But the indicated population turnabout is so dramatic that I find some people familiar with the area skeptical of the level of growth indicated. In Kansas and Missouri, the actual growth level of inmigrant counties has often been small because of the negligible amount of natural increase of population available. The broadest areas of inmigration are found in the Far West, usually in a continuation of past patterns. Inmigration areas are a broad mixture of metropolitan and nonmetropolitan territory, but with the extended influence of many metropolitan regions evident on the map, such as Atlanta, Houston, Dallas, or Minneapolis-St. Paul.

In marked contrast to the inmigrant counties are those that have declined in population since 1960. There are about 1,100 of them, or more than a third of all counties, but this is an improvement over the 1950's when 1,500 counties decreased. Immediately evident is the heavy concentration of these counties in the center of the country. In the east, the broad core of the Appalachians is still visible as a declining region, and there are many losing counties yet in the Southern Coastal Plain, where there is insufficient industry to absorb continued losses from agriculture. But these areas are small in comparison with the vast region extending from the Rio Grande at about Del Rio, Texas, northeastward to the Upper Peninsula of Michigan, west along the Canadian Border to central Washington, and then southeastward to Rio Grande again. In this territory, involving a third of the land surface of the country, the great majority of nonmetropolitan counties, are still in a state of population decline. These declines are typically occurring on community structures that are already affected by past outmigration, and on local population bases and governmental units that are already small both in total size and density. The population losses in this huge area are generally understandable, given such features as the continental climate, the increasingly extensive nature of much of the agriculture, the predominant lack of timber resources, the dearth of sizeable population centers and markers, and the lack of navigable water. But, how long can further population decline continue without impairing the ability of the region to conduct the productive agriculture that characterizes most of it?

Intermediate between the declining and the inmigrant counties are many that have had net outmigration, but have still achieved some population growth. Many of these have previously declined in population and their present status is one of improvement. Some are former inmigrant areas that have lost part of their past growth impetus, while others have consistently been areas of both modest growth and moderate outmovement.

The general national picture that emerges since 1960 is a marked reduction of population loss—and even resumption of population gain—in many areas that have large numbers of the rural poor. This is not a backing up of population, stemming from lack of opportunity elsewhere, for it has occurred during a period of high national employment. The areas now having the greatest difficulty in retaining population are the vast open lands of the midcontinent, plus the mountainous Rockies. Here the mass of the rural population is work oriented, reasonably well educated and housed, and unsaddled with an ethnic minority status; but economic and other attractions are apparently inadequate for population retention in nonmetropolitan areas.

The Relation of Gross Migration to Net Migration

The migration figures discussed have all related to net migration. They do not tell the whole story, but so often we have nothing more to work with. In recent years, two studies commenting on data on gross in and out migration have led to a conclusion regarding the pattern of outmovement from economically distressed areas that has been influential—at least in Washington—in shaping attitudes toward the likely impact of economic development on gross outmigration. I am referring to independent studies by Ira Lowry and by John Lansing and Eva Mueller [5, 3]. They noticed that gross outmigration rates from areas of substantial net outmigration were no higher than those of areas that had net inmigration. Rather, differences in net migration for depressed areas and growing areas seemed to be due solely to variations of the rate of gross inmovement. Acceptance of this broad generalization engenders a rather fatalistic attitude toward the potential for intelligently affecting outmigration. It makes gross outmigration appear to be so powerful and immutable a force that it flows without respect to economic or social conditions and cannot be modified by programs aimed at economic development.

Recently I have investigated the patterns of gross in and out migration in a more detailed manner than was germane to the larger work purposes of the Lowry study or possible from the small Lansing and Mueller sample. Gross in and out migration rates and net migration rates were computed for all of the 500-plus state economic areas for the period 1955 to 1960.[7] The areas were grouped by their net migration rates and mean gross migration rates computed for each group. Two major points emerge from this work that add to our knowledge of the relationship between gross and net migration and greatly modify the overly simplified concept of the relationships inferred from Lowry and Lansing and Mueller.

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[7] The basic migration data are in [9]. The base population of each area was taken as the 1960 population 5 years old and over, minus residents living in other areas in

1. Gross outmigration rates *are* related to the level of net migration. True, they do not vary as widely as gross inmigration rates, but they are neither uniform nor randomly distributed. The curve of gross outmigration plotted on net migration is a U-shaped curve, gross outmigration rates being highest in areas of heavy net outmigration and in areas of heavy net inmigration. They are low in areas of negligible net movement—in or out. Furthermore, the frequent equality of the gross outmigration rates of prosperous areas of net inmovement with those of depressed areas of net outmovement is not associated with the same factors, conditions, or motivations, and should not be equated in meaning.

For example, the gross outmigration rate from the San Francisco Bay area—a huge diverse prosperous area that is so often touted as one of our most uniquely attractive—was nearly the same as that from the Black Belt of Alabama, one of our more classic areas of rural poverty and racial discrimination. Would anyone maintain that people are compelled to leave the San Francisco area for economic reasons except in the rarest of cases, given the very wide range of occupations and industries and the high wage scale, in contrast to the narrow industrial mix and lack of net employment growth in the Black Belt? Is it logical to equate in their significance for national policy the surface similarity of gross outmigration rates from the two areas? I think not. Many other prosperous areas of substantial gross outmovement prove on inspection to be military or college centers with large temporary populations and resultant high turnover.

2. The second point is that variation in gross outmigration *is* the major component of variation in net migration among areas that have had moderate to heavy net outmovement. This has not been previously understood. Of the difference between 1955–60 net migration rates for areas of moderate net outmovement and areas of heavy net outmovement, about ¾ was caused by greater gross outmovement from the high net outmigration areas and only ¼ stemmed from lower gross inmovement to such areas. Thus, gross outmigration is not as lacking in response to depressed economic conditions as we have been led to believe. And the corollary of this would seem to be that increased economic opportunity in areas of need would reduce gross outmovement stemming from lack of basic employment activity.[8] Changes in gross inmigration only comprise the principal

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[8] The view that gross outmigration is about the same everywhere and thus that it is not responsive to economic conditions and unlikely to be affected by economic development has been widespread in the Office of Economic Opportunity. An influential staff document prepared in that agency in 1967 based this premise on the results of the Lansing and Mueller study.

determinant of net migration levels in areas of net inmovement or of low net outmovement—areas that those concerned with rural economic development policy are not especially worried about.

Population Change in Small Towns

Another facet of change in nonmetropolitan areas of the country around which there have been conflicting claims and beliefs is the trend of small towns. The fact that the term "small town" has no standard meaning is part of the confusion, for one person may think of places of only a few hundred people when he depicts small towns, while his listener may have a mental view of a place of several thousand population as the typical small town. These distinctions are vital, for the various size classes of small towns have typically fared rather differently in population trends, especially at the lower end of the size scale.

To improve our perspective on small town change, our office has compiled the incidence of gains and losses and the overall population change from 1950 to 1960 of nonmetropolitan towns of 1950, by size class. I am not sure that I have ever heard anyone with an overly favorable conception of what has taken place in the population change of small towns, but overly pessimistic views of an inaccurate nature are common. An example is a statement from an important speech of an official of the U.S. Department of Commerce, who said, "Small towns and villages, under 10,000–20,000 population, are disappearing except as residential or special purpose satellites of larger communities" [4, p. 8].

The facts do not correspond with this viewpoint. More than ¾ of all nonmetropolitan urban places of between 2,500 and 25,000 population increased in population between the last two censuses, and their overall growth (including the minority that lost) was 21 percent, exceeding the growth rate of the United States as a whole. Even the towns of the smallest nonmetropolitan urban class—of 2,500 to 5,000 population—grew by 18 percent, equal to the national growth rate. One might wonder what more in the way of demographic vitality could be asked of them. It is only among places of less than 500 population—which may not really deserve the name town in the first place—that population loss was more common than population gain (57.5 percent of them declined). But even here there was a small aggregate growth of 3 percent, because the gainers gained more than the losers lost.

To be sure, there are regional differences. Nonmetropolitan urban towns in the North Central and Northeastern States did not do as well as those in the South and West. And in the West North Central States there were 1,500 villages of less than 500 people that declined. Possibly because these *very* small places of the Midwest are so numerous, the impression has arisen that most "small towns" are decreasing in population, or "disappearing" or "dying," to use what seem to be the most popular terms. But such places account for only a small fraction of the total population of nonmetropolitan places, and their experience has simply not been that of small urban towns or even the larger rural towns.

It is not contended here that population growth in small towns is necessarily the same as economic growth. Some of the towns—the smallest in particular—have unquestionably had a decay of economic structure even with some increase in population, because of such factors as a larger population of retired age or the ability of people to commute to other communities for goods and services. But it would be ironic, in view of the proven viability of most small urban towns and the larger rural places from 1950–60, under conditions of government nonintervention and of extreme agricultural and other technological change, if they should now, during the present period of discussion of future public policies relating to the location of economic growth, be read out of the future because economists and others either fail to notice or inaccurately observe what has actually taken place in these communities.

The focus of this article is on demographic issues, but in fulfillment of the broader title given it, there are two comments on social considerations for rural policy that I wish to make. It is probably obvious from the paper that I am not an adherent of the "rural-urban-differences-are-dead" school of thought. This is not to deny or minimize the sweeping convergence in elements of life style or growth in rural-urban economic and social interdependence that we have witnessed in our generation. But have differences in attitudes and value systems merged to the point of insignificance?

Perhaps the most relevant research on this question is that of the sociologist, Norval D. Glenn. He has compared available national opinion and behavior polls over time that present data for urban and rural populations separately. The polls cover such subjects as attitudes and practices relating to freedom of expression, religion, childbearing, ideal family size, political affiliations, the role of women, capital punishment, and the regulation of liquor.[9]

For some topics he finds no meaningful rural-urban differences in either early or recent polls; for other factors, the differences are wide. On more than half of the items there has been some convergence of view, but in some cases very little and in others much. In other areas, there has been divergence of rural-urban opinions. Altogether, it is a very mixed bag and does not support a simplistic view that rural-urban social differences are uniformly disappearing or negligible.

On the premise that voting behavior summarizes and reflects in one index a host of social factors, I have examined the returns by counties of the 1968 presidential election. Rural and urban voting *per se* can not be determined, but metropolitan status of counties would seem to be a suitable proxy, for the metropolitan population of the nation is overwhelmingly urban and the nonmetropolitan population is primarily rural. In the election, 70 percent of the total popular vote was cast in metropolitan counties. The metropolitan plurality went to Hubert Humphrey, the losing candidate.[10] His three percentage-point margin over Richard Nixon in these counties was more than offset by Nixon's nine percentage-point edge in the predominantly rural nonmetropolitan population that cast only 30 percent of the total vote.[11] A difference in degree only, but substantial enough to control the outcome of the presidential election. I do not think there is any better evidence to be offered to support the view that important rural-urban differences still exist that must be considered in framing rural economic policy.

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[9] See [2]. The author is grateful to Dr. Glenn for supplying him with the rural-urban results of the individual polls on which his larger analysis is based.

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[6] Newspaper Enterprise Association, Inc., *The 1969 World Almanac and Book of Facts,* New York, 1968.

[7] U.S. Department of Commerce, Bureau of the Census, *Estimates of the Population of Counties, July 1, 1966,* Current Population Reports, Series P-25, Nos. 401, 404, 407, and 409, Washington, 1968.

[8] ———, *U.S. Census of Population: 1960, General Social and Economic Characteristics,* Final Report, PC(1)-1C, Washington, 1962.

[9] ———, *U.S. Census of Population: 1960, Migration Between State Economic Areas,* Final Report PC(2)-2E, Washington, 1967.

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[10] Humphrey, 46.1 percent; Nixon, 42.8 percent; Wallace, 11.1 percent.

[11] Nixon, 44.9 percent; Humphrey, 36.2 percent; Wallace, 18.9 percent. With some inaccuracies, the 1968 election returns by counties are available in [6].

The Economic Dimensions Of Rural Poverty

E. J. R. BOOTH

I PROPOSE to argue that the basic problem of rural America is substantial poverty that is no longer connected with farming; to insist that the stream of urbanization is not to be easily diverted in spite of our heritage of agrarianism; and finally, to offer a modification of a well-known proposal as a remedy for many ills.

The Agricultural Asymptote

The farm sector of the United States is fast approaching its equilibrium asymptote in relation to the rest of the economy. The facts are simple and even startling to one who last looked at them five years ago. By 1967, as Table 1 shows, the one million successful American farms produced all but 15 percent of the output and wound up with a total family income averaging $14,000. Both the intermediate group (sales $2,500–10,000) and the non-commercial group (sales less than $2,500) were averaging nearly $7,000 per farm family from all sources. It is very clear that these two groups, comprising over 2 million farms are no longer primarily engaged in farming. In seven years, the intermediate group switched its income dependence from farm to non-farm income, and the non-commercial group did more than twice as well as before in non-farm income. Moreover, even the lower end of the farm income distribution is no longer in dire poverty; these families prudently substitute enough non-farm income to replace on-farm opportunities. It should also be noted that in the whole of farming, non-farm sources of income are just as important as farm sources.

Table 1. Recent changes in the distribution by sales class of farms, and income, United States, 1960-67

Sales class	Proportion of item in sales class						Income per farm family					
	Farms		Sales[a]		Income[b]		Farm[c]		Off-farm		Total	
	1960	1967	1960	1967	1960	1967	1960	1967	1960	1967	1960	1967
			Percent				*thousand dollars*					
Over $10,000	21	31	72	85	58	14	3.1	10.6	1.5	3.2	9.6	13.8
$2,500 to $10,000	32	26	22	12	29	16	2.7	2.9	1.7	3.9	4.4	6.8
Less than $2,500	47	43	6	3	13	10	0.9	1.0	2.7	5.7	3.6	6.7
	millions		*billion dollars*									
Totals	4.0	3.1	35	46	12	14	3.0	4.5	2.1	4.5	5.1	9.0

Source: USDA [6, p. 72].

[a] Cash receipts, including net CCC loans.

[b] Total net farm income, including inventory change.

[c] Includes value of housing, home consumption, and government payments.

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None of this should be taken to mean that no problems remain for farmers. Clearly, success itself has caused its problems. Underlying the increasing income disparity between regions of our economy[1] has been a trend toward greater interregional farm disparity. The range across the states of total net farm income per farm has widened dramatically over the period 1949 to 1967. In 1949 the range was $8,240–from $946 in West Virginia to $9,186 in Arizona; by 1967, this had increased to $25,422–from $428 to $25,850–between the same two states.

There remain many farms and many regions no longer suitable for commercial farming. In the first seven years of the sixties, farm workers increased their support capacity from 25 persons each to 42 each, and farm family incomes increased by half. But this truly phenomenal increase in farm productivity did not affect equally all regions or all types of farms. Put in a more logical manner, these increased incomes stemmed primarily from favored regions and from the small, but increasing proportion of highly efficient commercial farmers.

There is no reason to suppose that any of the basic conditions for farming have changed in post war years. At retail, the income elasticity of food consumption has fallen to less than one-tenth while price elasticity remains at one fifth or less (see Appendix A). The essentially declining nature of the industry continues as expected. Output processes are still much longer than the average for other industries, and inputs like space, disease, or weather are hard either to control or to predict. Uncertainty continues unabated. The inability of farm managers in most climates to phase their production for increasing returns means that cost reductions must come from new techniques and so more and more specialized machines are idle more and more of the year. When market structure conditions are added to the above list, and the even more inelastic demand, price instability is a certain symptom.

It is clear that farming has adjusted in the post war period in phenomenal style. There is no longer much left of what we used to call "the farm problem." If public support in research and development, price stability, crop insurance, production loans, and cooperative marketing were continued and improved, the commercial sector of farming could fend very well for itself.

The "farm problem" of surplus labor and low incomes is diminishing to the point where a relatively small exodus from the non-commercial sector would bring about something close to parity for commercial agriculture. There are two ways of looking at this residual surplus labor of a declining industry. The first is from the parity income standpoint. Farm family income increased in the sixties from a level one-half that of national family income to nearly three-quarters in 1967. This means that if one-quarter of the poorest families could be removed from farming without much effect on farm output and subsidized out of all income, the farm and the nonfarm sector would come into parity. This means there is at least 25 percent labor underemployment in farming.

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[1] These trends, reported in [1] for 1948–60, have been reinforced by the data for the 60's.

From the standpoint of optimal labor-capital allocation in farming for the given aggregate technology, the measure summarized in Appendix B is appropriate. From this method, it appears that farming is at most 32 percent in labor surplus. For such a reduction in farm labor, with a concomitant increase of 20 percent in capital expenses, would maximize average labor income from the 1967 net output.

This range of estimated labor surplus proportions, as income figures have already suggested, is much lower than the estimates made during the fifties. More important, the absolute amount of labor surplus, some 1.5 million, is now a very small proportion of our national workforce. In agriculture, this is still a heavy load to bear. In rural America, where generations of farm out-migrants most naturally wind up first and last, the problems are even more severe. But they have nothing to do with farming.

The People Left Behind

I take this title from the report of the President's Commission on Rural Poverty [2] to advertise as well as I can the most incisive and objective report on rural problems that I have seen.

To summarize the findings of the Commission on the existence and location of poverty, a few highlights can be listed to make my second point—that just because there is no longer a farm problem does not mean there is no rural problem:

41 percent of our poor are rural.

60 percent of our poor are in rural areas and small cities.

25 percent of rural people are poor.

72 percent of the rural poor are not on farms.

60 percent of rural non-white are poor and concentrated in a few lowest income counties.

Poor whites are more numerous and more scattered.

Poverty is deeper in the country, with 95 percent of rural poor earning less than $2,000 (adjusted).

The average American woman 40 to 44 years old has produced 2 ½ children. White farm women average 3.7 children and the non-white, 6.4, when family incomes are lower than $2,000.

The rural people who emigrate come in two varieties: young and educated or old and poorly educated. The middle groups stay.

Americans starve in the country. The Southern Regional Council of Atlanta, Georgia, reported in 1967 that "thousands and thousands of children go hungry, go sick, and die a grim and premature death."[2]

These 14 million rural poor are the pool by which advances in urban welfare programs can be quickly diluted. They are spread thin enough not to be heard until they are concentrated in the urban ghetto.

The Urban Advantage

Town is where the money is.[3] This much is clear from Table 2. Two-thirds of our population choose to live in town, and the effect (or the cause, if you prefer) of this decision is a per capita income 12 percent above the nation's average, compared with a country income of 25 percent below. In fact, with only one-fifth of the total population, the seven largest cities of the nation produce 26 percent of its personal income, for a per capita income 28 percent larger than the national average.

The more urban a region is, the better its economic welfare. And time is not curing the disease. If per capita income trends as it has since 1940, town will continue to pull away from country at an average of $25 per person per year.[4]

Table 2. Income share of town and country, United States, 1929, 1959, and 1966

Region[a]	Population[b]			Personal income			Personal income per capita
	1929	1959	1966	1929	1959	1966	1966
		percent			percent		dollars
Megalopolis	20	21	20	33	27	26	3800[c]
Town	57	67	67	76	76	75	3314
Country	43	33	33	24	24	25	2236
		million			billion dollars		
Totals	122	177	196	86	383	580	2963

Source: U. S. Department of Commerce [8].

[a] I call "megalopolis" the 7 largest cities of 1966—New York, Los Angeles, Chicago, Philadelphia, Detroit, San Francisco and Boston. I call "town" all 223 SMSA's of 1966; and "country," the other 2700 odd counties called non-SMSA areas in the language of the Survey of Current Business.

[b] Population computed from income and per capita income, with adjustments for where received.

[c] Approximate.

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[2] As quoted in [2, p. 5].

[3] Unfortunately, Standard Metropolitan Statistical Areas obscure many interesting divergencies in types of urban or rural areas, but they are the best classifications we have to determine whether a rural/urban balance is being approached.

[4] The trend of per capita income difference between town and country for 1940, 1950, 1959, 1962, 1965 and 1966 was $\bar{Y} = 411 + 24.5T$, $r = .996$. The chance that

There is no evidence that the largest cities are growing faster than the rest of the country. By imputation, it is clear from Table 2 that the middle size towns are where the population and income growth is. This point has recently been emphasized by Dr. Stolnitz [3, p. 191], who notes that the proportion of urban people living in cities of a quarter of a million or more is lower in 1960 than in any other census year of this century.

The important conclusion from the facts illustrated is that the slight urbanization trend is nothing to be alarmed about in itself. This is no surprise when one ponders what a modern city is. It is chiefly a location where economies of scale prevail in all sectors except possibly in the public sector, where transport services are varied and adequate for large scale input-output transfer as well as commuter traffic and where the output complex is, on the average, income elastic so that the aggregate output is growing. It is also true that services are often expensive, but net standards of living are high enough to attract population.

Once cities become established, their comparative advantages are hard to compete against. While it is clear that diseconomies occur in large conurbations, they do not seem to occur until a population size of at least ½ million and they are apparently offset by the attraction of the varied output and job mix.

All in all, it is not surprising that the per capita income gap between town and country people had grown to $1,078 per person by 1966. What is surprising is that cities had not grown faster in size.

Agrarian Attitudes

In the days of Thomas Jefferson, who called farmers "the chosen people of God," agrarianism was a noble system. Perhaps through the 1930's, it was still relevant and helpful as an attitude toward United States society. However, agrarianism died as a useful concept by the end of World War II, and it is time we gave it a decent burial.

The sacred cows still low among us Let me give you a few examples from a pamphlet extolling "Communities of Tomorrow" [5, pp. 5–6]. This idea—of developing modern towns in the country to serve the new needs of land extensive farming and underemployed rural people—deserves better. But this is what it gets and I shall quote, supplying emphasis by italics and comment in between.

> ". . . in 1790, only 1 out of 20 Americans lived in an urban area. Today . . . seventy percent of our people live on about 1 percent of our land. If this trend is *allowed* to continue, 100 million more Americans will, by the year 2000, be stacked on top of the 140 million already in urban areas."
>
> "Our urban centers . . . are congested, noisy and full of tension, sur-

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any of these constants estimated was zero turned out to be smaller than one in a thousand.

> rounded by polluted air and polluted water, burdened with too many people on relief, many of whom moved in from the country, unskilled, uneducated, and unable to cope with city life. They are also costly."

My comment: People seem to like urban centers, as the last section showed. Perhaps we might not only *allow* this trend to continue but accept it and nurture it—even if U.S.D.A. is not to be involved.

> "In Washington, D.C., the cost for every commuter auto is even higher—$23,000. Contrast this with the $487,000 street department budget for an entire year in Fargo, N. Dak., a city of 50,000, for all its transportation facilities."

Perhaps we should also contrast the state of the streets in Fargo with Washington and the rate at which people move from Washington to Fargo.

> "'A city can get too big simply because the cost of providing services increases out of all proportion to total population growth,' reports Mayor Davis of Kansas City. 'This becomes perfectly clear when put on a per capita basis, which is about $120 a year in Kansas City. In a city twice this size, per capita costs would rise to more than $200 a person.'"

We might first wonder how much it would cost to build a community like Kansas City with over one million population and a production apparatus with an annual output of nearly $4 billion in personal income. One wonders also at what size costs are minimal and if we are talking about the same services when we compare costs. Lastly, it would be helpful in these analyses if we could include some notion of benefits. I had thought that we had advanced to the point where we understood that value has two blades. Perhaps costs are lower in Kansas City not just because of efficiency, not just because of scale, not just because of the type of service offered, but also because demand is low.

Communities of Tomorrow offers these alternatives:

Build towns and cities in the country.
Reverse the population flow to help towns adjust.
Locate teaching and research in the country.
Use the "space, beauty and underemployed people" of the country to expand industry.
Enable country communities *"to hold their young people."*
"Preserve the *maximum* feasible number of family-type farms."

These objectives are curiously reminiscent of the old rural development program. A mixture of new and old attitudes is exemplified by the first and last halves of the list. Just as the RDP assumed local industrialization was a sufficient condition for economic progress instead of just a necessary one, so the COT program assumes about urbanization. We refuse to learn that these passive historical forces are hard to divert, let alone to harness. Not that the country does not need some improvement of its community structure. But it will get it and maintain it only when it can support it. Man did not build cities and then discover they were conducive to economic progress. He created economic progress at transport, resource, and market nodes, and urbanization followed.

Worse than this misinterpretation of the cause and effect relation of regional development is the residual of shop-worn platitudes about keeping the young at home and preserving, or better, embalming, the family-type farm.

Somewhere, sometime, we must start to consider farming as an industry and rural America a residence with only adventitious connections. Somehow, we must abandon our Tung Nut mentality and programs.

Proposed Policies

To consider a set of general proposals for rural economic policy, we can proceed from a summary of conclusions from the facts already displayed.

There is no longer any "farm problem" as we used to call it.

There are many farm problems wherein agriculture differs markedly from other industries and merits help from the public sector.

The trend toward urbanization is not going to be easily modified, if only because it has been so successful and so costly.

Rural poverty deserves as much aid as the more concentrated and thus more demanding urban poverty.

During the next four years it is fairly clear that new programs will have to be substitutes for old programs, instead of additions as in the past.

This last point merits summary expansion. The economy is presently governmentally overheated. Our yearly federal deficit is running at $25 billion at a time when unemployment is almost at the theoretical minimum of 3 percent and prices are inflating at nearly 5 percent. Never before has it been so obvious that fiscal policy has so little to do with maintaining full employment but mainly fulfills the presumed demand for public goods.

The new administration is not likely to encourage the government sector to expand at the increasing rate of the last eight years. (Government purchases, which text books used to tell the young were a constant fifth of gross national product, are now up to 23 percent.) So I conclude that I must limit myself to suggesting substitutions of expenditures.

The following is a partial and very generalized list of some of the main priorities for new economic policies affecting rural America, some of which is still engaged in farming.

Phase out farm income support programs

During the last 3 years direct government payments to farmers ran at over $3 billion annually. The feed grain, wheat, and cotton programs account for over four-fifths of these payments. Although yearly totals vary, a fair measure of their average rate of increase during the sixties would be twenty percent per annum, and the 1969 federal budget calls for further increases.

As is well known, these programs are essentially income-supporting and retrogressive in incidence of benefits. By imputing a value of land resources above what they can be sold for without a program attached, these programs have tended to prevent economic resource allocation in farming. They may also have provided mobility disincentive to low income farmers.

These programs should be phased out gradually over five years to give time for adjustment of the misallocated resources. The yearly reduction of $600 million in gross income would fall mostly on large crop farmers and net income loss would be modified by some reduction in costs. Price effects will be mentioned later.

I have neither time nor inclination to go into the excruciating detail of these programs, which take thousands of men to administer, billions of dollars to finance, sixty pages to summarize in Agricultural Handbook 345, and one-tenth of the 1969 Budget Appendix to account for. Most are hold-overs from depression or war-shortage years. They stand as living proof that man's institutions are immortal, that we seem to be caught in a fable like that of the sorcerer's apprentice, who knew enough to make buckets and brooms do his work but not how to turn them off. I wonder how many remember the reason that Tung Nuts became one of the ten non-basic mandatory price-support commodities, or can recite the history and provisions of sugar legislation—a fine example of our propensity to amend, extend, but never abandon.

Strengthen production and marketing programs

As mentioned earlier, the special market and production conditions facing farm managers have not changed except to become more difficult. Public aid to guarantee production loans and crop insurance plans continues to be needed. The provision by U.S.D.A. and the Land Grant universities of a research and development department for farming still has the best benefit-cost ratio of any public program. One other type of program is to be suggested, but with reluctance because of past experience.

Farmers need marketing control, even if not to the full extent that almost all other industries possess it. Government aid will be required for this purpose to organize and help administer market orders and agreements and price stabilization (*not support*) programs. Farm cooperative and producer associations should have the major decision-making and administrative responsibility for quotas and prices but government help will be needed in many cases for legal, technical, and coordinating functions. The present programs are adequate, but should be expanded to other crops. Present public storage facilities for grain could be used by producer associations for output inventory control programs to stabilize prices. The critical point is to allow producers to monopolize markets to roughly the same extent that labor unions are permitted. This will become easier as farmers continue to specialize and as the numbers of producers of a commodity settle down to a floor.

Poverty programs

The main thrust of economic policy for rural areas should be directed toward the voiceless one-quarter of rural people, the fourteen million rural poor. Poverty programs should be simple, national, and directed toward a unique goal—money for those who lack it. The ways to provide money for the poor are as diverse as Babylon's tongues, and just as confusing. I want to be simple: My proposal is a national, standardized, income supplement program.

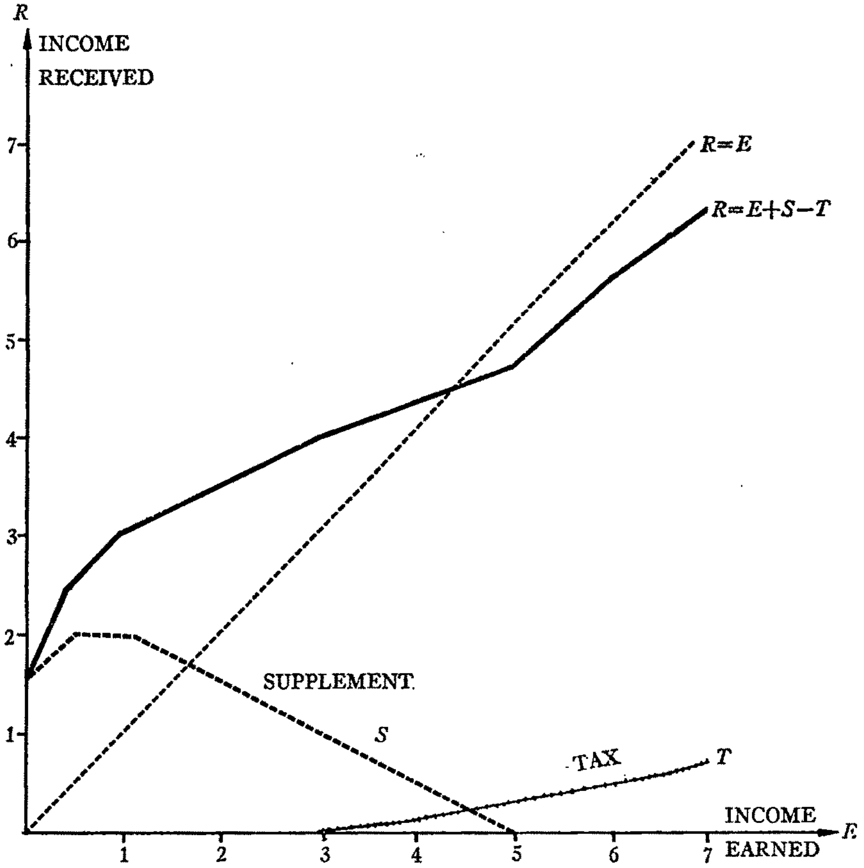
Once more, details must be submerged, but this proposal has been investigated in detail as the negative income tax. What follows differs in one important feature from those which I have read, such as outlined by Dr. Bishop [9, pp. 71–2].

There are two major types of poor family, those with a potentially employable head of family, and those without. For the latter class of families, money for the rearing of children capable of jumping the poverty hurdle is all that can be done. For the former, there is the problem of efficiency or incentive. I propose, that for families with a member capable of work, we define a minimum bare subsistence, a minimum which varies with the size of the family and the cost of living; but for the family of four today, this would be around $1,500. Then, for incentive, the government would add one dollar of supplement for every dollar earned up to $500. For the second $500 earned, the total income supplement would remain at $2,000. Then, as the family earned more than $1,000, the supplement would be reduced by fifty cents for each added dollar earned until supplements ceased at the earned income level of $5,000. Before this level, ordinary income tax would be levied from $3,000 of total income and upwards.

Figure I illustrates the possible ranges of income earned and income received in such a proposal for the typical working poor family. Several special features are worth notice.

The program should be administered by the Internal Revenue Service without regard to residence, occupation, or race, more or less as our federal income tax is now administered. No other agencies should be involved in any way.

Of special relevance to rural-urban balance is the still cheaper cost of living in the country (especially when the family is living on a farm)



(thousand dollars per family)

Figure 1. The income supplement incentive plan

which would mitigate the march to the ghettos. For the "farm price problem," a special provision must be included to deny eligibility to any who produce farm products for sale.

Studies now in progress on the negative income tax should be used to generate information about the wage elasticity of labor supply from poor families and how this elasticity changes as labor supplied increases. The knowledge would aid in determining the optimum level for the "breaks" in the plan (presently assumed as $500, $1,000 and $5,000) and also the level of wage subsidy (now assumed as two for one, one for one, and half for one over the three ranges). But let us stay simple so that the recipients can fill in their income tax forms with no more help than the honest middle class.

The effects of negative income tax on incentive have often been deplored. This is why most proposals include the provision for a gradual reduction of benefits as income rises. But the most difficult thing for the poor to do is to take that first step toward gainful employment. Wages for these people are usually below minimum national standards in occupations where the disutility of labor is high. But doubling their wage rate for the first $500 earned, as proposed here, would tend to balance this disutility; and once a work record is established, the better paying and more rewarding occupations become available. Minimum wage legislation would need to be reviewed to ensure that enough occupations were covered so that the effective subsidy to labor intensive industries is not overdone.

Of crucial importance is to take all the myriad welfare agencies out of this game and to make country benefits more than equal to town benefits, the reverse of which is true of present programs. Benefits would be paid for by those who can afford to, including the rural and suburban rich, through a reasonably progressive income tax.

The total cost of such a plan does not loom very large, compared with other government expenditures. And saving from other welfare plans, including farm income supports, would be expected to equal these costs. For a balanced attitude toward budget allocations, it is well to recall that the federal government presently pays out $13.5 billion annually in interest payments on its debt and, in 1967, was already shelling out 12.9 billion in cash benefits to the poor. It is the distribution of these payments that is so inequitable.

The definition of unemployability is always critical in welfare programs that retain a modicum of incentive. My own predilection is toward the minimum of rules that tend to make the plan work equitably as well as efficiently. Remember that enforcing rigid rules is not only damaging to the incentives and attitudes of the poor but typically costs more than the savings. The problem of the pseudo "broken home" is a case in point. The husband who stays away from home to maximize total welfare benefits also demonstrates that there is a lot of income incentive left among the disadvantaged. To harness this may be less costly than to try to stamp it out. If we should discriminate in any direction, we should make the typical family have the highest payoff and let "unrelated" individuals fend for themselves, with less than they would get as a share of "family" income supplements. The problem of subsidizing the reproduction industry by aid to dependent children should also be faced. A declining scale of supplements for each child over two or three might be acceptable if we did the same for the rich, with declining dependent allowances for income-tax purposes.

Finally, these income supplements should be automatic, regular, and tied only to the completion of an income tax-supplement form sent to all families. Free school lunches, food stamp plans, and special commodity programs should be available up to their presently authorized levels to all who want to use them, but should be gradually phased out. The income supplement plan should be the *only* welfare program for income support.

Employment programs

The best long-run employment program is free school education up to age eighteen. In the short run, retraining programs are most helpful if directed toward job shortages that are likely to occur at the *end* of training. For such retraining programs, I prefer to rely on the people who will use the labor and know best what jobs will be available—private industry. Once again the tax-subsidy approach might be considered. Since no company likes to train workers for its competitors, the government would have to subsidize by a contract to pick up that portion of the costs that industry proved it could not recover.

I am very much against public work programs for only one reason—they do not work. I think that would be fair assessment of the Job Corps. And I am against the Government being the employer of last resort, as the Rural Poverty Commission recommends. This is because, staffed by the efficient civil servant, no government agency is willing to remain only the last resort, even if it were to start that way. Government is already overstaffed. The flavor of handouts and make-work is just what we need to avoid for the poor. If more public works are needed, let them be done in the most efficient manner, with the poor trained to participate like others.

Rural urbanization and industrialization

These programs are clearly not yet major, compared with the size of the problems attacked.[5] The prospect of continuing rural urbanization the way we started rural development is sufficiently frightening to warrant a few warnings. Just as a glove factory placed in a rural area will only prolong the local agony, so the attempt to build an outmoded town of 100,000 in a dying area is doomed. As Professor Wilbur Thompson puts it so well [7, p. 16],

"Small towns will surely survive for a while, if in no other way on the hand-me-downs, the cast offs of the industrial system . . . The farther we go through the system of cities in industrial sophistication, . . . the lower the average age is low, there is a stronger case for measures to stimulate the local economy to take advantage of a highly elastic supply of labor. I have been very sympathetic to this position in the past and my own work reflects this bias. Nevertheless, in all fairness, we should recognize that there may be insurmountable obstacles to successful local development despite the favorable labor supply situation. Skilled labor and management may be in very short supply, access to markets and materials may be very poor, and social services may be of very inferior quality. The point is, however, that we should not rest the case for public intervention on these grounds. The inescapable social responsibility is to assure the healthy development of the human resources which emanate from these high fertility areas. If it can be accomplished via economic development, fine. If not, it must be managed in some other way. We can ignore these areas in which substantial numbers of young people are growing up only at our national peril.

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[5] In 1967, expenditures and net lending totaled $167 million for area and regional development under the Department of Commerce, of which the Rural Community Development Service managed some $44 million [4]. Small business assistance came to $176 million, and there is no means known to me to sort out the rural component from published data. Water and sewer loans by the Farm Home Administration grossed $175 million. Housing and community development programs spent $577 million, and net lending, including that to support private housing projects, totaled $1.7 billion.

The other point has to do with the implications of these findings for the "urban crisis". We can draw some comfort from what appears to be a retardation in rural to urban migration and the continued viability of small towns. But not too much. Our major urban centers no longer require heavy inmigration to generate the kind of absolute growth which raises serious questions about their economic efficiency and their social stability. The urban problem is here and will not go away even if rural to urban migration ceases altogether. Moreover, given the high fertility rates of Southern Negroes and other rural ethnic concentrations, there is no reason to expect a complete cessation of precisely that kind of migration which has given the urban crisis its most pressing dimension.

Discussion: Demographic and Social Dimensions of Rural Economic Policy

Lee R. Martin

Booth and Beale have presented excellent papers and deserve our gratitude for refocusing our thinking toward important issues.

Booth's paper may be divided into three parts. The first part places rural poverty in context, by identifying the poor and their sources of income and by showing some of the changes that have been taking place in metropolitan (town) and nonmetropolitan (country) areas. The second part argues strongly that improvements in rural welfare cannot (should not?) be achieved by public intervention in the on-going "urbanizing"

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process. The third part outlines a poverty program for rural and urban America, as follows:

1. Phase out farm income support programs over five years.
2. Strengthen production and marketing programs.
3. An attack on rural and urban poverty built around the negative income tax. Negative taxes would presumably be permanent for a poor family headed by an unemployable; the incentive provision would be expected to push potentially employable family members toward training and/or gainful employment. Eventually, welfare programs would be dismantled in favor of the income supplement program. Annual costs are estimated roughly, equaling something like Orshansky's poverty income gap ($11.5 billion) minus savings in the farm support program (as much as $3 billion) plus cost of strengthening production and marketing programs (unspecified) minus savings on existing welfare programs (not estimated).
4. Employment programs built around education for youth and adult retraining programs conducted largely by private industry.
5. A modest program of rural urbanization and industrialization, limited to "a few selected already-growing medium-sized cities."

Booth does an excellent job of placing the rural poverty problem in context. He presents only some of the most recent evidence and allows it to speak for itself, which it does dramatically. A little more information on recent changes in the structure of poverty would have been instructive.

I have nothing but praise for Booth's courageous attempt to devise a program that would do something about rural poverty. Few agricultural economists have been willing to make specific suggestions or even to discuss the problem of what to do about rural unemployables. Unequal treatment of rural and urban poor is argued to be indefensible. Reliance upon better basic education as a poverty-prevention measure and upon job-related retraining as a prescription for existing poverty is very attractive.

I must take issue with Booth on his arguments against serious attempts to create more employment opportunities nearer to the rural unemployed and underemployed. I believe he ignores some of the evidence and interprets the considered evidence in an unwarranted manner. Let me summarize my position in a series of statements.

1. Booth seems to base his case largely on a quote from Wilbur Thompson, but his quote does not represent Thompson's statement [1] adequately. The statement is much more balanced and less extreme than the quote would imply. Thompson's full statement [2] provides an even more balanced and thoughtful treatment of the issue of relative advantage.
2. As I read them, the conclusions of Borts and Stein [3] and of Rich-

ard Muth [4] provide little support for the Booth hypothesis, relying rather more on the characteristics of the labor markets to explain differential rates of growth in employment and income.

3. The analyses of rates of 1962–66 employment growth by Haren and Peak [5, esp. Figure 4] and of rates of 1940–60 population growth by Fuguitt [6] do not provide much support for the hypothesis that nonmetropolitan counties are inexorably going down the economic drain.

4. Beale's companion paper also presents cogent evidence on the role of size in economic viability; I will return to this evidence shortly.

5. As Weidenbaum [7] points out, Federal expenditures have large effects on the geographic location of economic growth. The argument that all or even most of these expenditure allocations are closely related to economic (or social?) efficiency does not seem justified. By way of example, the economic growth of California during the 1950's and of Texas during the 1960's seem to have been fed heavily from the Defense Department and NASA budgets. I have found no credible evidence that different allocations of expenditures would have been substantially less efficient.

Mr. Beale presents recent demographic trends that are relevant to economic growth. Two bodies of evidence relate to Booth's arguments. First, between 1950 and 1960, more than three-fourths of all nonmetropolitan urban places between 2,500 and 25,000 increased in population, and their over-all growth was 21 percent greater than the rate for the U.S. as a whole. Second, recent estimates of 1966 county populations revealed that "completely or primarily rural counties did much better in retaining their potential population growth from 1960 to 1966 than they did in the 1950's."

Beale also broke out gross 1955–60 outmigration rates into rates for the 500-plus state economic areas and found, contrary to two more aggregated studies, that gross outmigration rates are related to the level of net migration.

For Booth's consideration, I would offer the hypothesis that, carefully designed and carried out, policies to influence the location of certain types of economic activities toward nonmetropolitan and smaller metropolitan urban centers may well offer one way to circumvent the Phillips Curve. The missing pieces in the puzzle are the costs in efficiency (if any) of such policies, and the reduction in social costs (if any) of a less rapid rate of population growth for large metropolitan areas.

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AGRIBUSINESS AND OTHER AGRICULTURAL ECONOMISTS: COMPLEMENTARY, SUPPLEMENTARY, OR COMPETITIVE?

CHAIRMAN: LEONARD J. HAVERKAMP, WILSON AND COMPANY

What Agribusiness Economists Need from Theoretical and Empirical Agricultural Economics

A. C. HOFFMAN

THE land grant colleges have traditionally trained agricultural economists almost exclusively for careers in the agricultural establishment —i.e. for farming itself, for university teaching and research, for service in the U.S.D.A., the Foundations, farm organizations, etc. Recently many departments of agricultural economics have undertaken something new and fundamentally different, the training of economists for careers in business and industry.[1] This may turn out to be one of the most important ventures ever made by the profession.

I want to make it clear at the outset that I think this is a good and commendable thing. But a great deal more is involved than adding a few courses and restructuring the curriculum of agricultural economics to give it some semblance of a business school. It will ultimately involve, I think, a new look at some of the basic postulates and preconceptions of agricultural economics. Put bluntly in terms of the topic assigned me, I think agribusiness economists will need something very different in the way of theoretical and empirical economics than most departments of agricultural economics have traditionally offered. The substantive part of this paper will deal with the specifics back of that statement. But first let's try to get the agribusiness economist and his job in perspective as it relates to his training.

Training Requirements for the Agribusiness Economist

When a business firm plans to market a new product, it usually does some research as to the size, preferences and requirements of the market it plans to enter. And before a department of agricultural economics goes

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[1] Although there are important differences between corporate and cooperative business enterprises, I think the management methods and problems of both are very similar and becoming more so. For this reason, most of what is in this paper I would regard as applying to both types of enterprise, although on this I defer to the better judgment of Dale Butz.

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overboard for the training of economists for business, it too should perhaps do some market research for the product it plans to offer.

The first observation to be made is that the market for economists in business is a comparatively limited one. Usually only the larger firms hire economists, and among those usually classified as agribusiness I doubt there are presently more than two hundred positions for economists—only a fraction of the number these same firms have for other types of management functions.

The second thing to keep in mind about business economists is that most of them work in a staff position. These are important and relatively well-paid jobs, but they are not usually classified as upper line management, with the result that as business economists go up the ladder, they frequently transfer to positions in line management for which they may regard their training in agricultural economics as too narrow. Moreover, even in their capacity as staff economists, they are frequently called upon to work on projects involving corporate finance, long range planning, acquisition studies, marketing research, operations research, computer application and other management functions outside the usual range of economics.

What this adds up to is that the agribusiness economist should be trained not only in economics but also for general business management. A corollary to this is that the type of training traditionally offered by our colleges of agriculture and their agricultural economics departments is not, in and of itself, adequate to this purpose. This does not mean that colleges of agriculture should not orient themselves to help in the training of some of their students to enter business, because, for whatever the reasons, that is where a lot of them will end up. It does mean that the training role of agricultural economics departments should frequently be a supplementary one, and they should not seek to duplicate courses and disciplines which are better provided elsewhere on their respective campuses.

Recently some of the members of the Chicago Agricultural Economists Club held a special meeting to offer suggestions for discussion at our session today.[2] You may be interested in their consensus as to the essentials and objectives of training for the agribusiness economist (as given to me by the Club's recording secretary for that meeting): "What we need in the management function of problem solving and decision making is well developed reasoning ability and an analytical mind. The emphasis should be on the development of the capacity for logical and incisive thinking. We should ask the colleges to stress courses in logic and philosophy somewhere in the total academic work of every Ph.D. candidate. It is the quality of the mind that matters rather than the extent of the applied knowledge (which will rapidly become obsolete) of the agricultural society."

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[2] Members of the Club made many other suggestions that were very helpful to me in preparing this paper, but its shortcomings are mine.

Measured against this standard, the typical undergraduate curriculum taken by most agricultural economists leaves a good deal to be desired. Too much of the course work is narrowly vocational, there is too much orientation toward the physical sciences, and correspondingly too little in the direction of such basic disciplines as the humanities, the social sciences, psychology, communication, mathematics—even a little philosophy as the doctoral degree itself implies. Maybe the best thing a department of agricultural economics can do for its undergraduate majors is to restructure their curricular requirements so they can take as much work as possible completely outside the college of agriculture!

But there are some things which agricultural economists can do better than anyone else, and I think they are very important things. More than most economists, those in agriculture have a tradition for problem solving. Men like Fred Waugh, John D. Black and Ray Bressler were not afraid to take their economics into the market place and apply it to the problems they found there. For the agribusiness economist with problems on his platter, I should think their writings and their methods would be more useful than the esoteric algebraic dialogues on which some of the younger academic economists today spend so much of their time.

A second great tradition of the agricultural economist is that he pioneered, and today leads most other branches of the profession, in the *quantitative* approach to economics. The U.S.D.A. and the land grant colleges have always recognized the need for economic data and provided them. Thanks to this tradition, agricultural economists are without peer in their ability to compile, analyze and present data—and they are the greatest price analysts in the world. These things are of high value to the agribusiness economist.

Within the past decade or so, business has become increasingly interested in computer analysis and operations research as an aid to decision making. Maybe I'm old fashioned, but somehow I distrust these techniques unless they are combined with a knowledge of economics. For this reason I think it is particularly commendable that several departments of agricultural economics—notably Purdue—have added operations research and computer analysis to the analytical arsenal which their students are given. This type of thing is excellent for everyone concerned.

Finally, let's take a quick look at the "raw material" (i.e. the students) for the product you will be offering the business world. To some extent, the increasing number of students electing to take courses in agricultural economics as training for business results from what might be called a surplus of raw material rather than the excellence of the training offered.

When young men from the farm go to college, they have a natural orientation toward agriculture and frequently enroll in the College of Agriculture rather than in some other college or division of the University, even though they know at the time they almost surely will not be returning to the farm. Then as their career plans shape up, many of them develop an interest in business and elect to major in agricultural economics for the somewhat negative reason that its content comes nearer than that of any other agricultural department to the type of training they think they need. This student raw material surplus, coupled with what could be an approaching saturation point in the demand for agricultural economists in the traditional agricultural establishment, may make it a matter of incumbency as well as of choice that departments of agricultural economics begin training more of their students for the business career market. For whatever the reason, I think you are going to be doing more and more of it from now on.

What Agribusiness Economists Need from Theoretical Agricultural Economics

The main theory postulates of agricultural economics are essentially those of classical economics—i.e. perfect competition, an atomistic economic structure, the "scissors," and Adam Smith's old dictum that the hand of the master best fattens the ox. From these postulates, agricultural economics developed most of its economic principles relating to such matters as enterprise scale, selling and price making, capital sources and requirements, and enterprise management. For the most part these principles are appropriate to the understanding and analysis of traditional agriculture and the family farm; but in industry, where the agribusiness economist has to make his way, things are no longer this simple.

For instance, during the past several decades some very fundamental changes have been taking place in the structure of agriculture—(1) the virtually complete transition from farm type enterprises to factory types in the poultry industry, and to a lesser extent in the livestock industry; (2) vertical integration by food and feed companies toward agriculture and even into farming itself; (3) and the sharp growth of the optimum-sized commercial farm, with resource requirements beyond the capabilities of the traditional family farm.

Now these developments were of tremendous importance to agriculture, yet there was almost nothing in the dialogues and researches of agricultural economics to presage them. For agricultural economists with careers in public service, this failure to foresee and participate as economists in these things was not a crucial omission—they were busy with other things and the basic preconceptions of agricultural economics assured that such things weren't supposed to happen anyway!

But what of the agribusiness economist. One of his important functions is to foresee and foretell for his company the direction and degree of change in the structure of agriculture. Imagine his predicament if he had been working for a company which was a supplier to the poultry industry and he had advised it to plan its long run capital expenditures on the assumption that poultry would continue to be produced mainly in farm flocks!

Another postulate of classical economics, which is of less than no value whatever to an agribusiness economist, is that relating to selling and marketing. The classicists did not recognize the function of selling as we know it today in an industrialized, affluent society. Essentially they identified selling as the mere offering of a homogeneous commodity, under what they called conditions of perfect competition, in an atomistic economy. From this it followed that any departure from any of these postulated conditions was *ipso facto* a bad thing from the public standpoint—or more specifically that large-scale enterprise, product differentiation, advertising, merchandising, all selling expenses except those necessary physically to offer and move the produce—all these were either monopolistic, wasteful or unnecessary. This is still the essential position of a large segment of the agricultural establishment, although not so rigidly and universally held as a generation ago.

Now this is not the place to argue the basic issues involved in modern marketing as it exists today in most segments of the American economy. I mention it here because chances are the agribusiness economist is going to spend his life working for big business, and if he doesn't understand and believe in its basic rationale, including its marketing program, then he is going to be very unhappy indeed. I should think he would be well advised to get his training in marketing in the business school across the campus rather than in most departments of agricultural economics.

Perhaps the greatest contrast between industrial enterprise and traditional agriculture is with respect to capital and management. Here again the received doctrine of agricultural economics is at odds with the world of the agribusiness economist.

In agriculture the family has traditionally provided the capital and owned total equity in the farm enterprise. The sources of capital were whatever savings the farmer could make as he climbed the agricultural ladder (if indeed he could climb it at all), inheritance and/or marriage, and the short term mortgage. Clearly and for well known reasons, this system for providing capital is obsolete and inadequate today, and this is the main reason why capital from outside the traditional format of agriculture is now pouring into it.

This new capital is taking several forms and coming from some new sources. Sometimes it takes the form of the agribusiness firm furnishing supplies and equipment to its patrons, sometimes it loans them money, are all three of these things to each other, and there is nothing wrong in this because it is not necessary that we strive for similarity and full accord in all matters. But it is essential that our interests, our priorities and our economic preconceptions *not become so dissimilar that we become in effect two separate disciplines,* each tending to ignore the other and with no basis for common dialogue. There is, I am afraid, more than a little evidence that we are drifting further apart than we should, which is the fault of all of us and to the benefit of none.

Addendum

After I had written my paper up to this point, I let it lie around for a week, then re-read it, made some changes, and decided it needed this addendum.

I have said some rather harsh things about traditional agricultural economics, but I did not mean this paper to be an unfriendly one. I think it is wonderful that agricultural economists are beginning to train students, do research and seek greater rapport with the agribusiness community. I hope that on their part agribusiness firms make the response your efforts deserve, and I hope for the sake of everyone that you succeed.

There are those who will say that any kind of rapport with agribusiness is somehow wrong because the interests of agriculture and those who supply it and process its products are inherently opposed. In some respects and in some situations this may be true, but on balance I think it is not true. Whether true or not, this is no good reason why you should not seek to maintain student training and research liaison with all segments of agriculture and agribusiness. I'm sure you can do it without selling your souls.

What Agribusiness Economists Can Contribute to the Content and Equipment of Agricultural Economics

PATRICK J. LUBY

TO BORROW from famous words spoken by the late President Kennedy in his inaugural address, our President Breimyer has given agribusiness economists a real challenge, "Ask not only what agricultural economics can do for you but what you can do for agricultural economics." As that phrase jolted many citizens eight years ago, this title caused me to look at a few things in a little different light.

For many years, I believe, some of our agribusiness economists have been attending the annual and winter AEAA meetings, have been reading or at least scanning the AEAA Journal, attending other meetings set up by agricultural economists at various universities and drawing information and knowledge from "one on one" situations with their academic and government agricultural economist colleagues. They apparently have found these opportunities rewarding.

While our Association and its economists in public service have set up these opportunities for agribusiness economists and utilized annual meetings and its official publication for the dissemination of knowledge, I know of few similar situations or communications on a formal basis where agribusiness economists have attempted to be the disseminators with the rest of the profession as the principal recipients.

I have reviewed the AAEA Journal for 1966, 1967, and 1968 to gain some insights into agribusiness economists' contribution to the profession by means of its official publication.[1] If my research is accurate and if we define agribusiness economists to include only those employed by private profit-seeking firms, thereby excluding staff members of Federal Reserve Banks, foundations, trade associations and the like, we have had only one article published by an agribusiness economist in the four regular issues. One essay was co-authored by an agribusiness economist. There were also six papers and four discussion papers presented by business economists in the Proceedings issues of 1966 and 1967. Most, if not all, appeared to be invited papers. If we define agribusiness economists to include those of the Federal Reserve Banks, foundations, trade associations, etc., the total rises to over thirty, including those of discussants. (Incidentally, on our

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[1] For purposes of discussion, I have defined "content" to mean the "total body of thought" contained in agricultural economics, and "equipment" to mean the "tools, methods, and know-how" needed to apply the knowledge to the problems or to attempt to gain new knowledge to add to the body of thought.

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Association's formal programs, I believe it may be in the role of discussant that the agribusiness economist can best be utilized.)

I did not check to see what percentage of total articles, essays, viewpoints and reviews the above represented. However, I believe it is safe to say that it would be considerably below the percentage of agribusiness economists listed as members of the Association. The latter percentage is not definitely known. In 1967, Dale Butz served as chairman of the Industry Committee of our Association which surveyed agribusiness economists and sent out 325 questionnaires [1]. The membership of the Association in 1966 included 4,157 individuals [2]. This gives us some idea of the proportion of agribusiness economists in our total membership.

This raises the question of why agribusiness economists and especially those employed by commercial, profit-seeking firms do not publish in our Association's Journal. Is it because they have nothing to contribute or because of other reasons, such as lack of time or incentive? Or are agribusiness economists contributing to the discipline by other methods rather than the Journal? I believe they are and will comment more upon that in a moment.

There are, I believe, differences in the incentives to communicate through formal association channels. We have heard much about the probably overemphasized "publish or perish" mandate in universities. Indeed, the public economist is often required to publish the results of his research. On the other hand, it is "profits or perish" in the business world and this may discourage the long tedious procedure required for Journal publications. And if it is highly proprietary information one in business writes about, it is probably "publish and perish" for that individual.

I suspect there are few differences in the time demands of academic and business agricultural economists. Both groups have more problems than time. But I believe that a journal article is looked upon as one of the best uses of time one can make at most universities not only by the writer but also by his superior. I doubt if the same attitudes toward the optimum use of time exists in most businesses. Also, the large supply of bright, young, aggressive graduate students at reasonably favorable wage rates does, I believe, give the academician a sizable advantage over the agribusiness economist when it comes to pursuing problems in depth and reporting on the research in "journalistic" style.

Agribusiness economists and economists-turned-manager may also feel after some years that they are unable to write in the jargon of the discipline for Journal purposes. The writing style exhibited in many Journal articles is quite different from that of business memos or even from most detailed research reports to management in business.

There also may be a basic difference in the preferences between academic and business economists. There is some feeling that the Journal editorial council leans toward articles reporting new research methodology.

It may be that economists who prefer to work at and attempt to extend the horizons of research methodology choose to work in the university environment where the climate may be better suited for such activity. On the other hand, economists who go into business may as a group prefer to use known methods and tools to find new knowledge or apply knowledge already known to real and pressing problems.

Whatever the reasons, it appears that agribusiness economists have not been large contributors to the profession through what is probably the principal means set up by our Association.

However, I do not want to leave the impression that the Journal is the only means by which one can contribute to the content and equipment of agricultural economics. I am sure our many good campus teachers and extension teachers feel they contribute much. In fact, our Association has set up annual awards to officially recognize their contributions.

By the same token, I do not want to leave the impression that agribusiness economists have not contributed to the profession or have deliberately avoided communication with their colleagues. I believe that most public economists who have been responsible for programming conferences, seminars, workshops, and the like have usually found the agribusiness economists receptive to invitations to participate actively as speakers. If one were to review regional and state programs developed by our agricultural economists, I believe he would find a much higher degree of agribusiness economist participation that has been true if measured by our Journal. Sometimes, I sense that there may have been more invitations, except that our university and Washington friends try not to impose upon us and our time. Perhaps this is a delusion. Maybe they have found us unwilling or unable to contribute. Others will have to help me answer this question.

Potential Contribution to Content and Equipment

Apparently the agribusiness economists make up less than 10% of the membership of the AAEA. What can this small group, almost an appendage of the AAEA, contribute?

In the AFEA Industry Committee Study of 1967, about half of the agribusiness economist participation than has been true if measured by our experience in industry. By virtue of their tenure in industry, they have made or participated in innumerable business decisions. Whether managers or staff economists, they have made or influenced courses of direction of firms. As Galbraith pointed out in his recent book, *The New Industrial State*, in today's complex economy, specialists working together as teams form a "techno-structure" which really "makes" the decisions. The economist is usually one of such a group and sometimes organizes and directs the team in problem solving.

Consequently, it is from experience in this environment that should come whatever contributions agribusiness economists can make. To a profession interested in the total agriculture-food complex, this group, representing employment in a sector which is responsible for about 60% of the "value added" to food, should be able to contribute much from its day-to-day living with the problems. This is not to say that others in the profession, by virtue of research and consultation, cannot also contribute. In fact, many do. But agribusiness economists possess a uniqueness of occupation along with a knowledge of the agricultural economics profession which should be of value.

This uniqueness of occupation, paridoxically, does impose a sizable restriction which must be recognized. Agribusiness economists study the motivations and methods by which business policies and decisions are made. They are in a unique position to know for their own firms what these forces are and how they interact in the market. But that knowledge is somewhat confined to their own firms, and the typical agribusiness economist probably hesitates to generalize in print from it for at least two reasons: (1) the observations may not be valid for the total business community (or even for the industry), and (2) to publish the generalizations obviously reveals competitive attitudes, strengths and weaknesses of his firm and may not be tolerable in the competitive world.

Most business economists, agri- and otherwise, are employed by sizable corporations. This is natural and to be expected. Such corporations have the organizations and the range of problems which can justify and attract the service of highly and formally educated economists. Likewise, such corporations are usually found to be in industries which are not very well described by the perfectly competitive model. Therefore, most agribusiness economists are part of decision making in firms in industries which are imperfectly competitive in textbook terms.

For this reason it would seem that they should be of assistance to the rest of the profession to describe, at least in general terms, conduct of management in decision making in firms competing in industries of imperfect competition. Many questions which are not answered precisely in textbooks must be answered daily in business. How are products and markets developed? How are products merchandised? How does a firm try to differentiate a product or service? What is the role of advertising? How does one measure its effects? How does one study the consumer? How does one estimate the effect of a firm's decision to expand or contract capacity on the firm itself and on the rest of the industry? How do firms and industries live with overcapacity for long periods of time?

How do firms plan growth, change, investment and divestment strategies? How does a firm develop an acquisition policy? How are production and processing plants and distribution outlets located? How are joint costs, overhead costs allocated? The role of cost accounting is important for we may have a beautiful pricing system in agriculture, but if farmers, processors or retailers do not really know what it is costing them to produce and market various kinds and qualities of goods, the system will not perform and direct production and consumption in the efficient and effective manner that the theories say it should. How are marginal concepts used in determining pricing procedures, production decisions? What problems occur and how are they attacked in developing international markets? How does or can industry combat rural and urban underemployment problems by plant location, training of the unskilled and hardcore unemployables? These are just a few of what must be many more questions of common interest to all in agricultural economics. It would seem reasonable to believe that many agribusiness economists would have accumulated experience working with many of these questions and problems.

Many agricultural economists have received most of their direct formal training in management with reference to the management of a farm—an atomistic unit whose manager's decisions have virtually no effect upon competitors, the industry or the price received. As time goes on, the management of firms in agriculture appears to be taking on more of the aspects of industrial firms. As this occurs, the insight into the management and behavior of industrial firms obtained by agribusiness economists should be helpful to and utilized by publicly employed agricultural economists. Also, agriculture as an industry is faced by chronic overcapacity problems. Firms in many agriculturally allied industries have also been forced to manage in similar situations. Economists from these firms should be able to report on how industrial management works within such a setting. In what I thought a very convincing manner, Breimyer developed these concepts in a note in the Journal recently [3].

The agribusiness economists grappling with the problems of risk and uncertainty in a complex economy with rapid technological and social change should be producing thought and tools which other agricultural economists can apply to other problems in agriculture, which is in the midst of very similar environmental forces. Many agribusiness economists have become deeply involved in "long-range planning" for their firms in these times of change. To swim in these waters, it would seem that they must develop styles and use strokes which could be shared usefully with economic planners in the public sector.

Other agribusiness economists continue in various fields of economic research. Here they use the equipment acquired in our various educational institutions. While as a group they may prefer to be users of such equipment rather than basically interested in developing new tools, it seems unlikely that these many able, inquisitive practitioners have not out of necessity, if for no other reason, developed new tools or new "twists" to old equipment in performing their duties. Many are employed in the fields of sales forecasting, production planning, product formulation and price and supply forecasting where they have constant need for the best tools available. If our earlier hypothesis is true that the problems and management tasks in the rest of agriculture are taking on more of the characteristics of modern industrial firms, many of the tools developed by agribusiness economists should be of use to others.

It might be argued that many economists "leave the profession" and become managers and therefore cannot and do not contribute. I do not agree with this premise. Many economists from their managerial positions are capable of contributing even more to the body of thought of our profession. An outstanding example of this is the preceding speaker, A. C. Hoffman, active in management for years at Kraft but one of the more frequent contributors in recent years to agricultural economics.

I have tried to develop the thesis that although there are some real problems of confidentiality in some areas of thought and tools, agribusiness economists do have something to contribute to agricultural economics. I have also tried to develop the premise that with some exceptions they have not been contributing as much as they can. It seems to me, for reasons expressed early in the paper, that most business economists are unlikely to use the normal Journal route of communications as a delivery mechanism. I believe that business economists lack the incentives and environment that university people have to publish, especially in our profession's Journal.

Also, it may be that too often in the past, when agribusiness economists have been invited to a platform, they have been invited to participate only to "defend industry's position" on certain questions or have used (or misused) the opportunity and defended a position or argued a case. While such debates may have a very useful purpose in some circumstances, I believe that too often they prevent high level communication of knowledge and ideas.

One of the real challenges of the Association as I see it is to promote useful communication between the two groups. The lack of dialogue in the past may have contributed to or prolonged the apparent polarization of economic philosophies between many public service economists and many of the agribusiness economists.

What can be done to bring business economists more into the mainstream of our Association and make this a more mutual exchange of knowledge is outside the scope of this paper. I believe that the efforts of Dale Butz, Leonard Haverkamp and others during the last five years or so have been steps in the right direction. The annual industry dinner at the summer meetings has given certain identity to industry economists. I believe that if the desire is there on the part of both agribusiness and public economists, a method will be found which will provide dialogue and the mutually beneficial exchange of thought.

What agricultural economics is or what it should be has been discussed at some length in recent years. Added to what it is or what it has accomplished is the fact that it has contributed, along with several other disciplines, hundreds of business economists and managers with advanced academic degrees in industry today. In this paper the arguments have been developed that these people, by the uniqueness of their business experience, have contributed but are able to contribute still more to the content and equipment of agricultural economics. It also appears that this "feedback" is not likely to come through the profession's Journal. The challenge to agribusiness economists to contribute more is a serious one. The challenge to the profession to arrange an effective delivery mechanism for this potentially greater contribution is also serious and would seemingly be open to anyone in the profession.

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Discussion: Agribusiness and Other Agricultural Economists: Complementary, Supplementary, or Competitive?

CHARLES E. FRENCH

The profession could have been doing more in agribusiness. Thus, I am sympathetic with the tone of both papers. Yet, I differ substantially with my good friends. My remarks may even sound harsh. Fundamentally, I hope to emphasize the tone they set by criticizing some points.

Agribusiness may be slipping professionally relative to other businesses. Therefore, the tone of this session should be one of alarm.

Dr. Hoffman said we are problem solvers, pioneers, and we do more for misplaced farm kids than other educators. This justifies our existence.

I will not worry much about these two types of economists being complementary, supplementary or competitive. Many complementary and supplementary aspects exist. Competitive relations are trivial. This was

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well established in the great *Saturday Review* discussion in January 1957. Other fine literature has come along since that time.[1]

We may be better at method than at subject matter. I do not understand Dr. Hoffman's thrust: "Agribusiness economists will need something very different in the way of theoretical and empirical economics than most departments of agricultural economics have traditionally offered." Just how different can you get? Our theoretical and empirical economics have not been that far off. We can be criticized for how we do the job, but our basic objectives and notions are fundamentally correct. We advance, modernize, and raise our standards just as an agricultural business does. Criticism of our mode of operation may be well founded, but doubtful relative to our basic intent.

Both talk of our preoccupation with classical economics, family farm organization, internal capital supply, farm management and agricultural science. Hogwash! This is simply not our current type of training. Dr. Hoffman uses structure of agriculture as an example of where we are old fashioned. This area has had an almost repulsive amount of work. We have probably led the economics profession in many aspects of structural analysis. Vertical integration work has moved along. Our students understand behavioral concepts. Planned subsector analyses promise much.

Both speak of management and economics separately. Modern notions with matrix algebra bridge this gap. Ironically, this came in algebra, not in calculus. But it is here. Integration is probably the most catalytic word of this generation. Management and economics will be integrated more.

Subject matter and problem definition are what bother me. Both speakers say we are weak on the demand side. I agree. Dr. Luby gave a most intriguing and impressive set of questions. These we must study.

My plea is for reasonable emphasis on commercial, agricultural, and firm analysis. The AAEA presidential addresses for the last ten years were:

1959 Cochrane — Technology and Farm Supply
1960 Nicholls — General vs. Agricultural Economics
1961 Allin — Price and Income Policy
1962 Brandow — Farm Policy
1963 Hardin — Service and Internationalism
1964 Johnson — Domestic and Foreign Policies
1965 Bachman — Foreign Development
1966 Witt — Food
1967 Bishop — Urbanization and Poverty
1968 Breimyer — Institutionalism

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[1] For example, see *National Study on Agribusiness*, Michigan State University, 1961; *Educating Tomorrow's Managers*, CED Report, October 1964; and *Conference on Curricula in Agricultural Business Management*, University of Missouri, 1966.

These say little about firm work. If we drop firm and commercial orientation, we should do it by design, not by default.

Both papers today put emphasis on large companies. Great agribusiness opportunities exist in smaller companies.

We have also become sophisticated. Agribusiness reminds us that they are sophisticated now; we must grow up. We are also sophisticated. We also produce to specifications. Neither company represented here would place an order with any supplier with the uncertain specifications of these papers.

We train from sub-B.S. to post-Ph.D., for line or staff, for staff as transition to line, generalists or specialists, domestics or internationalists, managerialists or operationalists. We are training better men than many agribusinesses are hiring. Also, we may be giving better training than our products get a chance to use.

Dr. Hoffman says there should be better demand analysis for our people. I agree. Both companies and universities would gain. Our students have great curriculum freedom. The problem is not in freedom to take but what to take.

It is popular to quote Galbraith. I would refer to his early work, *The Liberal Hour,* which emphasized the fact that industry should have more influence on our training programs, but certainly they should not dictate them.

Dr. Hoffman mentioned the action in the capital area. Good agricultural economics departments are strengthening their finance areas.

We perform a dual function. We deal in young people. In a sense we are personnel officers as well as educators. Often now, agribusiness personnel officers spend one-half hour or so with our top seniors. They make selections. The next we hear is from a top executive, advising us that he has been trying to hire one of our promising young staff men. Recruiting activities in between are few and far between. The opportunities are many with training concepts, graduate programs, and internships.

Interestingly, our most active cooperative training ventures are with small-to-medium family businesses. Your best technocrats will in many ways be home-grown. But a home-grown apple needs some spraying. We need to get together on the training of company people and on more logical recruiting methods.

Our supply base for young people is much wider than indicated in these papers. The farm boys probably have some assets, but certainly all of our people are not farm boys.

The Chicago Agricultural Economists Club said, ". . . well developed reasoning ability and an analytical mind. The emphasis should be on the development of the capacity for logical and incisive thinking. . . . It is the quality of the mind that matters rather than the extent of the applied knowledge. . . ." This type of man can best be found where only the bright are considered, where theory is mastered, where quantitative rigor is practiced, where written and oral proof is rendered to a group of discerning men who have seen several good applicants previously, where general appreciation for specialty depth and generality of various subject matter exists, where there has been pressure of a long period of hard work which failed to break the man, and where one solid professor can speak from a long tutorial relationship with the man. That is the format of a good graduate program. Here the personnel selection process is sophisticated.

Action exists in this area, but it is not all labeled agribusiness. Good men can be picked up in any good business or agricultural economics program; and additional specialized training, if necessary, is not difficult to acquire. Specific action exists at Purdue, the University of California (Davis), the University of Minnesota, Oregon State University, and the University of Missouri. Companion programs with other departments are available at Michigan State University and Cornell University. Programs or serious discussions exist at Pennsylvania State University, North Carolina State University, Ohio State University, Washington State University, the University of Wisconsin, Kansas State University, Iowa State University, and Louisiana State University. On many programs I am relatively uninformed, but action can be found in many places, and many young men are being sorted out.

We can do much together. Division of labor is not as important as complementary effort. We need more than just critical comments from agribusiness economists. I cannot agree with Dr. Luby to relegate them to paper discussants. We need more than passive use of company data and companies themselves for laboratories. This is great service, but we need more. We need more than agribusiness economists writing in journals. Frankly, I doubt that they will write for journals, nor am I sure they should. Let me hasten to say they should if they wish. The Journal needs them.

The great need is dedication to drive through from theoretical insight to profit-and-loss statement. This takes hard work. Our operations research work has emphasized this.

Some specific possibilities are: (1) Training internships at the B.S. level; (2) Training grants and involvement programs at the graduate level, with some grantor strings to avoid dilution into general school budgets; (3- High-level workshops on problem definition, such as Dr. Luby's list, with a limited number of high-level academic and industry people working hard and openly without this foolish secrecy espoused by some companies; (4) Workshops on method such as some recently successful ones; (5) Research grants with specific terms of time and product so as to allow use of technicians and postdoctorals to expedite the work; (6) Research training grants on problems that accommodate graduate students; and (7) Reminders to each other that education is a continuous process, so both industry and universities will get on the ball with modern approaches, particularly through university adult education programs.

Discussion: Agribusiness and Other Agricultural Economists: Complementary, Supplementary, or Competitive?

DALE E. BUTZ

I believe that Oscar Hoffman has put his finger on the key product that agribusiness needs from colleges and universities—trained and well qualified people. While he has tended to lump training of undergraduates and graduate students together, I am sure that he would agree that there are some very important differences between the training needs of undergraduate and graduate students. For the most part, the undergraduates will be moving into sales, administrative, or other positions, whereas graduate students will be primarily interested, at least initially, in research positions. Too often, graduate courses are merely beefed up versions of undergraduate courses.

I would like to emphasize the point made regarding the need for colleges and universities to research the market for the product they plan to produce or offer. Too often, I am afraid, professors, department heads, or others assume that they know best what should be in the curriculum and how it should be presented, without bothering to research the market. Those college faculties in close touch with the outside world through consulting arrangements, part time extension assignments, or other means, have an opportunity to check whether their course content and their students are geared to meet the needs of today's world. In today's fast changing economy, particularly the agribusiness sector, it seems safe to say that many universities have not really bothered to see whether their curriculum and their students are prepared as well as possible for the job assignments they assume. My personal experience and the comments of my colleagues lead me to believe that the training of agricultural economists for positions in industry is in general less than optimum at most institutions and very poor at many of our Land Grant universities. I believe that most agribusiness economists and executives would be willing to advise on training needs if they were asked to do so.

Dr. Hoffman has listed several major additions to curricula and training

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DALE E. BUTZ *is with the Illinois Agricultural Association.*

that would prove to be helpful. I should like to add another general area that I believe represents a major weakness in many agricultural graduates, both at the undergraduate and graduate level. I am referring to the ability to communicate in both oral and written form. Very few men or women work in a vacuum. They must communicate if they are to be at all effective. I do not know to what extent good communications are based on innate ability and how much can be acquired. I do know, however, that some skills can be acquired through training, experience, and supervision. In our training programs for agricultural economists, we seem to assume that the degree automatically confers on the recipient proficiency in communication. I believe most of the graduates come up short in this area, and this can be a real handicap in terms of work effectiveness and advancement in the agribusiness sector. Many of those with whom they must work will not be impressed by the depth of the agricultural economists' knowledge if that knowledge cannot be converted into a form useful to the others in the agribusiness firm.

I would like to second Dr. Hoffman's comments regarding the problem solving orientation of agricultural economics. Perhaps I'm beginning to show my age, but it does seem to me that the orientation has swung too far away in some fields from this comparative advantage of agricultural economics. This trend has tended to lessen the direct value of academic research to agribusiness firms. It also has resulted in less close working relationships between academic economists and the business world. Today's university graduates also seem less able to grapple with and solve practical problems.

I believe Dr. Hoffman was a little harsh on the academic economists in assuming that they all stick pretty close to the theory postulates of Adam Smith and other classical economists. Many agricultural economists and many institutions have broadened their training curriculum and research programs to include the dynamics of imperfect competition of the real world.

Dr. Hoffman lists three broad types of research that might be helpful to agricultural economists: (1) case studies in business management; (2) service studies for industry; and (3) broad studies of important problems of commercial agriculture. I agree that all three areas would be helpful, but I have about given up hope of getting case studies or service studies done in time to be of much value to agribusiness. Most universities are not geared to conduct research or publish results in the time span required by agribusiness firms.

I share Dr. Luby's concern over the lack of industry economists' participation in such things as journal articles. While I believe that this may reflect the difference in basic orientation to "publish or perish," I also think that there may be other compelling reasons. One is the fact that many industry economists have difficulty in figuring out how many of the current journal articles can be useful to them in their work. Consequently, they feel ill prepared to put together articles that they fear will not fit the mainstream of the current literature. In addition, they can not afford to spend the time if there is seemingly a good chance that the final product will be rejected by editors.

While I agree with Pat that industry economists have been useful to their university colleagues in conferences, seminars, workshops, and the like, I doubt that the contribution in the area has been as great as it might be. To achieve anywhere near maximum benefit from this type of activity requires, in my judgment, several key ingredients. In the first place, the university staff must sincerely feel that the industry economist has something to offer. Secondly, the industry economist must be willing to devote precious time to assisting in college or university programs. If a close working relationship is established, it would seem to me that the industry economists could be of great value to the university over and above the usual conference or meeting programs. I refer to such things as in-depth analyses and review of the university research program in fields of interest to the agribusiness economist. Another aspect that might be covered is training needs of agricultural economists for business. I have the feeling that many business economists are willing to help if economists in the college are really willing to listen. If academic economists listen superficially and then attempt to refute any suggestion and to justify their position, they will not get much assistance from their industry brothers.

I agree that industry has much to offer the academic economist. The real problem, as I see it, is what kind of a mechanism can be set up to help realize the potential in this area. One possibility, which I believe deserves consideration, is that of some type of business fellowships under which university economists and others would have an opportunity to spend time as full-fledged staff members of an agribusiness firm. I realize there are several such plans in operation now, but most are of relatively short duration. I am thinking of a minimum of six months and preferably a year. This would have to be underwritten by the business firm, but since the university and the individual also stand to gain, they should share in the cost. The venture should be policed so that the business firm or other firms do not recruit the academic person until a reasonable time period has elapsed after his return to university work.

University staff people could gain valuable insight by doing more consulting work. This is not an automatic procedure; such people usually have to achieve some degree of proficiency in a field before they are sought out as consultants. Some institutions and some professors frown on or do not encourage consulting. Apparently they feel that an individual who does consulting work, especially with industry, is in some way a "kept" person. While this is a possibility, it will happen only if the individual lets it happen by compromising his professional ethics.

Another way in which industry economists can be of great value to the profession is by taking an active interest in the affairs of the American Agricultural Economic Association and by maintaining close contact with the departments of agricultural economics in the major territories in which their particular agribusiness firm may operate. If in these contacts both parties frankly express their feelings on various issues, I firmly believe that both the industry and academic economists and, indeed, the entire profession will gain through the exercise. If we remain silent or do not communicate, the profession is likely to be frustrated and divided.

I believe that we have made progress in recent years in the recognition of the industry economists as an integral part of the American Agricultural Economics Association. We all have much to gain from further developing the mutual benefit that can accrue from close working relationships between industry and academic economists. This will not happen automatically since, as Oscar Hoffman has indicated, the trend may be in the other direction. This trend, however, if it does exist, is not irrevocable. If we really take to heart the ideas presented by the speakers here today, we can build bridges of understanding among all segments of our profession.

EDITOR'S NOTE: This section of the *American Journal of Agricultural Economics* may include comments on and replies to previous articles and other literature in agricultural economics, suggestions for improving the effectiveness of the AAEA, discussions of changes in emphasis needed within the profession, and contributions on other topics of interest and importance to agricultural economists. Manuscripts submitted for this section should be prepared in accordance with the guide appearing on the inside of the back cover of this issue and should not exceed 1,000 words.

Communications

CAPITALIZATION OF BURLEY TOBACCO ALLOTMENT RIGHTS INTO FARMLAND VALUES

Capitalization analyses and implications for income distribution have shown that one of the longer-run effects of the Federal production control-price support programs has been the capitalization of the income benefits from allotment rights into higher farmland values (see Clawson [3], Floyd [4], Schmid [8], and Wilcox [9]).

A study at Kentucky, designed to estimate empirically the sale price of burley tobacco allotments and thereby the extent to which the income benefits of the burley tobacco programs are being capitalized into higher land values, indicates that the capitalization of burley tobacco allotments has paralleled that of other types of tobacco and indicates a continuing upward trend in allotment values as yields and prices for burley tobacco have increased.[1] This analysis dealt with sale prices of whole farms and the contribution of the allotment to the sale price of the farm in deriving the estimates of value of burley tobacco allotments.

Five geographic areas of Kentucky were selected for the study, on the basis of the relative importance of burley tobacco to total agricultural income as indicated by density of production. From these areas, all farmland transfers occurring between January 1, 1959, and December 31, 1962, were tabulated from deed records in the local offices of the county clerks. A total of 2,356 farm sales occurred during this period in the areas sampled. After deletion of atypical market transfers, a total of 1,217 usable observations remained.

The data were analyzed by multiple regression procedures according to the model $Y = a + bX_1 \ldots\ldots bX_6$, where

Y = Sale price of the farm in 1957–59 dollars,

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[1] A study by Maier, *et. al.* [6] in 1960 estimated value of flue-cured allotments by a multiple regression approach. Later studies by Gibson, *et. al* [5] in 1962, Bradford and Toussaint [2] in 1962, and Seagraves and Manning [7] in 1967, using regression, budgeting, and programming, have confirmed the capitalization hypothesis for flue-cured tobacco and have refined the quantitative estimates for values of allotments.

X_1 = Acres of burley tobacco allotment,
X_2 = Acres of cropland,
X_3 = Acres of noncropland,
X_4 = Appraised value of buildings on farm in 1957–59 dollars (logarithm),[2]
X_5 = Location index (average = 100),[3] and
X_6 = Per acre value of burley tobacco production (yield times price) in 1957–59 dollars.

Significant partial regressions were obtained for each of the independent variables included in the analysis.[4] The net burley allotment regression indicated the contribution of an acre of allotment to the sale price of the farms was approximately $3,387 in 1957–1959 dollars. This is slightly higher than the average of $2,985 reported for flue-cured tobacco by Seagraves [this issue] for the same years. However, gross returns for burley were higher than for flue-cured, due to slightly higher yields and prices.

The aggregate analysis was known to contain many observations of small farms that had been bought mainly for the tobacco allotment or had been purchased by urban employees as a place of residence and operation as a part-time farm. Commercial farm operations have allotments mainly between 1.0 and 5.0 acres. For farms with allotments of 1.0 to 5.0 acres, the net regression indicated an addition to farm sale price of $3,689 for each acre of tobacco allotment. All independent variables were significantly related to the sale price of the farm except value of burley production per acre, which approaches statistical significance at the 5 percent probability level. However, on commercial burley farms, value per acre for burley varies relatively little from one farm to another.

Adjustment of the per acre regression estimate for burley allotments to a 1967 basis was made by adjustment upward in line with increased gross returns per acre from burley.[5] Adjustment of the allotment-farm sale price regression to a 1967 basis gave an estimate of $6,015 per acre as the net addition to the price of a farm resulting from an acre of burley allotment.

Costs and returns studies for burley tobacco in the Central Bluegrass Region of Kentucky indicate the net returns to allotment and management at approximately $670 per acre in 1967 [1].[6] This would indicate that an investment of $6,015 in an acre of burley allotment (the regression estimate) yielded a net return of approximately 11.1 percent. Farmers bidding for allotments, in the process of buying farms, apparently discounted expected net returns at approximately double the current rate of interest. The rate of return on allotments would be expected to be considerably higher than current interest rates for two reasons: (1) the necessity for purchasing whole farms in order to acquire allotments, and (2) risks associated with the future direction of Federal programs related to tobacco, including the prospects for future reduction in purchased allotments. Since allotments are purchased only through the purchase of whole farms, the discount rate for net returns (11.1 percent) indicates considerable confidence on the part of producers in continuation of the production control-price support programs in about the present form. This is consistent with uncertainty discount rates for flue-cured tobacco, ranging from 12 to 21 percent (average, 15.0) during 1959–62 [Seagraves, this issue].

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[2] X_4 converted to logarithms, because farmers tend to bid less than full value for farm buildings when buildings are more than adequate for housing and farm operation.

[3] Location index based on soil type and productivity of the area in which the farm was located, type of road on which farm was located, distance from schools, churches, and other community facilities, and general terrain characteristics of the area in which the farm was located.

[4] $Y = 99.17 + 3386.98X_1 + 96.97X_2 - 16.67X_3 + 1007.21X_4 + 24.17X_5 + 1.47X_6$; $R^2 = .85$; all partial regression coefficients significant ($p < .05$).

[5] Adjustment based on the assumption that land received a constant share of the increase in gross returns from burley between 1959–62 and 1967.

[6] 1958 estimates adjusted for changes in production technology, with family labor valued at $1.50 per hour and land rent at $20.00 per acre. The $1.50 labor cost appears to be in line with hired labor costs and opportunity returns for family labor.

Rental of the tobacco allotment on a cash basis is a fairly common practice in burley producing areas. Generally, such leasing arrangements require that actual production of the tobacco be on the land holding the allotment. Records on cash rentals in the Central Bluegrass Area of Kentucky for 1967 indicate the leasing of some allotments on a sealed bid basis at approximately $480 per acre, with the lessee furnishing all production inputs except the land.[7] An investment of $6,015 (the regression estimate of sale value of the allotment) would return $480 at an approximate 8.0 percent interest rate—somewhat lower than the capitalized net return to land and management, as would be expected in view of the fact that the allotment owner avoids the management input plus any supervisory tasks not identified or allocated as a labor input in budget analysis studies.

The analyses indicated that, at current prices for allotments, a substantial portion of the benefits accruing to producers from the acreage control-price support programs have been capitalized into higher land prices. In the 12 counties for which data were obtained, approximately 3 percent of all farms changed ownership during each of the years, 1959–62.[8] While the original allotment holders were the major gainers of the income effects of the program, purchasers of farms and allotments throughout the history of the burley program have benefited differently. The largest increases in allotment values for flue-cured tobacco have occurred since 1952 [7], and it appears that this is true also for burley. Rising yields resulting from technology have increased the productivity of each acre of allotment for all major types of tobacco, and price supports have maintained tobacco prices that are high relative to all agricultural products. However, as yield-increasing technology has developed, allotments in total have been reduced to maintain supplies of burley roughly in line with manufacturing and export needs. Thus, burley tobacco allotments in the U.S. totalled 250,000 acres in 1967, compared with 374,600 acres in 1940, the first year of price supports.

Summary

Continuation of production control and price supports for burley tobacco over many years has resulted in increased producer returns for this crop.

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[7] Land rent estimated at $20.00 per acre.

[8] If .03 is a valid probability for transfer of a farm in a single year, then the probability that a farm was transferred during the 35-year period of allotment history (1933–67) is approximately .65.

As producers have come to accept the Federal programs in burley tobacco and to believe in their continuance, the allotment rights to produce have acquired value. When farmland involving allotments changes ownership, a part of the earning value of the allotment is included in the price for the farm. As a result, the new owners do not receive the full price and income benefits of the program.

Analysis of sale prices of over 1,200 Kentucky farms indicated that, in 1957–59 dollars, an acre of burley tobacco allotment added approximately $3,689 ($6,015 in 1967 prices) to the sale of the farm. Estimates from regression are consistent with allotment returns from cash rentals and from discounted net returns and are consistent with estimates of allotment values for flue-cured tobacco, the other major cigarette type of tobacco produced in the United States.

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CREDIT IN THE PRODUCTION ORGANIZATION OF THE FIRM: COMMENT

Professor Baker [1] has provided some useful insights into the effects of credit use on farm organization. Because of the unique manner in which credit charges and lenders' attitudes affect resultant input costs, credit use may cause the optimal product mix to differ substantially from the norm of the internally financed farm. Indeed, the optimal farm organization may differ widely even among farms using credit, depending on the source of credit and the lenders' appraisal of the borrower.

The essence of Professor Baker's article is that, because of the manner in which the credit market enters the farmer's decision-making framework, the farmer is not a pure competitor in the input market. The implications of this are many. For example, neglect of explicit credit sources may introduce errors into normative analyses, such as farm planning and supply response studies. Input prices and quantities may not be predetermined, as is often assumed in aggregate studies, but may be determined during the growing season by credit supplies, lenders' expectations, etc. In general, any studies involving the assumption that farmers are pure competitors in input markets may be affected.

Professor Baker concludes that we need to know the characteristics of the credit supply functions of lenders. However, because of the important implications of his findings, it would seem to be of some interest to investigate the *a priori* conditions under which the credit supply functions will not cause a shift in resource use from the norm of the internally financed farm.

The firm is assumed to be a pure competitor in the input markets, but must finance the purchase of inputs. Cost of variable inputs is thus given by

$$C = u(1+i) + v(1+j)$$

where $u = p_1x_1$; $v = p_2x_2$ and i and j are the interest rates which are determined as some functions of u and v, respectively. C can be interpreted as a credit limit. One of the necessary conditions for cost minimization, given a specified output level, is in this case

$$(1) \quad -\frac{dx_1}{dx_2} = \frac{p_2[1+j+vj_v]}{p_1[1+i+ui_u]}$$

where j_v and i_u are the derivatives of j and i with respect to v and u, respectively. (The credit supply functions are assumed to be monotone increasing with continuous first derivatives.) Only when the bracketed terms in (1) are equal will the credit user have the same minimizing solution as the internally financed firm. Under what conditions can the bracketed quantities be expected to cancel?

First, suppose the lender is completely indifferent to the type of input purchased and regards interest only as a function of total credit extended. In this case, $z = u+v$, i is identically equal to j and is a function only of z, the derivatives are also identical, and the bracketed terms cancel. This presumably represents the case in traditional theory in which borrowing does not affect input allocation.

The next simplest case would be one in which i is a function only of u and j only of v. This might occur because the loans are self-liquidating, because of different sources of credit, etc. In this case, cancellation requires that $(j + vj_v) = (i + ui_u)$. Thus, even if i and j were equivalent algebraic functions of u and v, respectively, the two terms would cancel only if $u = v$, that is, only if the farmer were to purchase the same total of each input. For n inputs, he would have to spend $1/n$ of total credit on each input. This type of symmetry is not to be expected in general. When the credit supply functions are not identical, the conditions for cancellation of the brackets become more complex but appear equally unlikely.

It is probably more realistic to suppose i and j are not independent functions of u and v but rather that i and j are each functions of both u and v. In this case, the necessary condition under discussion becomes

$$(2)\quad -\frac{dx_1}{dx_2} = \frac{p_2[1 + j + vj_v + ui_v]}{p_1[1 + i + ui_u + vj_u]}.$$

When the cross-partials, i_v and j_u, are zero, (2) becomes the same as (1). When the cross-partials are not zero, they appear to offer no increased hope that the use of credit will not affect resource allocation. Again, even if the credit supply functions for i and j were identical, the terms would cancel only when $u = v$. When the functions are not identical, there appears to be no generalization that will insure, *a priori*, that the allocation of resources will not differ with credit use.

When the lender reacts to the farmer's credit requests by varying the loan limit, the situation is equally bleak. The cost is then given by

$$C = du(1 + i) + bv(1 + j)$$

where d and b represent the rate at which the lender reduces the farmer's loan limit. d and b can be constants or may be functions of u and v. In the latter case, d and b will enter the minimizing conditions in a manner similar to that described above for i and j as functions of u and v. Even when constants, d and b will enter (2) as follows:

$$-\frac{dx_1}{dx_2} = \frac{bp_2[1 + j + vj_v + dui_v]}{dp_1[1 + i + ui_u + bvj_u]}$$

so that even the existence of identical credit functions and equal division of expenditures between x_1 and x_2 will not insure cancellation of the bracketed terms.

A cursory examination of the necessary conditions for the allocation of two inputs purchased with the use of credit suggests that credit use can in general be expected to affect the allocation of inputs. A detailed investigation would require much more space than available here, even without dropping the naive assumption of monotone continuous credit supply functions. However, further investigation under more complex conditions would probably reinforce the conclusions of this note. Thus, Professor Baker's article is indeed extremely relevant to research in farm management and production economics.

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TOWARD A CONCRETE CONCEPT OF EFFECTIVE COMPETITION: COMMENT

In a recent provocative article [5], Professor Stephen H. Sosnick specifies operational performance standards of effective competition. The article has much merit, but some additions and revisions seem necessary to achieve the objective of developing useful performance standards by which real markets can be judged.

1. An essential of effective competition, relegated by Professor Sosnick to only two words in a footnote [5, p. 842, footnote 21], but stressed by

(presumably as necessary conditions of effective competition) "increasing diversity in the structure of production and consumption," "new products and processes and improved institutional arrangements," and "wide diffusion of the benefits of progress." None of these criteria appeals to me because none is definite. For example, in a Sacramento supermarket the number of different brands, types, and sizes of 14 commonly used grocery products[1] increased from 17.6 per product in 1962 to 20.4 in 1968 [1, p. 41]. Whether this increase in diversity satisfies Dr. Pritchard's norm is not clear, since he does not state what kind or amount of increase in diversity he requires. Similarly, a demand for wide diffusion of the benefits of progress will not be definite until it is explained how to decide when the amount or duration of profits has exceeded what the record of innovation justifies.

I have another objection to demanding increasing diversity of products. More diversity (unlike more progress and, perhaps, unlike wider diffusion) is not, in my mind, necessarily or even usually preferable to less. Increasing diversity ordinarily increases the costs of production and distribution. It may also add confusion. To illustrate, Consumers Union sent five women to buy the 14 staples mentioned above. The women were instructed to disregard quality and to select the package that offered the lowest per-unit price for each of the 14 items. Despite spending an average of 50 minutes in the store, the women, all of whom were college educated and regular shoppers for their families, made incorrect choices on 38 out of the 70 opportunities. In 1962, a similar group of women took less time (43 minutes) and made fewer incorrect choices (34 out of 70). Because both confusion and costs increase with product diversity, diversity may be excessive as well as insufficient.

Is there an acceptable criterion of excessive diversity? One might say that diversity is excessive if there is a variation that no buyer finds useful, or if the variations have been carried beyond the point where the extra diversity is worth the extra cost to buyers, or if a reduction could be made that would improve the position of some people so much that they would be better off even if they had to compensate everyone who would be worse off. While I find these criteria acceptable, none seems to be definite, and I can think of no acceptable alternative that would be usable in practice either. That is why I mentioned product diversity only in passing.

To have no specific criterion concerning product diversity, however, is not really to ignore the subject. The trouble in the Sacramento supermarket is what I characterized (page 849) as "information less complete, reliable, or available than would maximize a measure of traders' collective gain from trade in the market, net of information costs." In particular, the trouble is, as Consumers Union points out [1], lack of per-unit pricing (except for meat). Without per-unit pricing, many consumers apparently cannot even rank prices, let alone evaluate different price-quality combinations. With per-unit pricing, equilibrium with perfect competition. But to phrase the question in terms of what imperfections are tolerable implies that the structure, conduct, or performance attributes of perfect competition are desirable, that closer approximations to them are preferable to more distant approximations, and that the relevant task is merely to decide how much deviation is normatively acceptable. And none of these implications is acceptable. E. H. Chamberlin and J. M. Clark have explained the defects of the first two implications. As to the third, I tried to explain (page 839) why introducing tolerances creates trouble; tolerances are arbitrary, and to adopt them invites labeling a situation *effectively competitive* even though it contains removable defects. Accordingly, I see only problems arising from viewing the objective to be the identification of acceptable degrees of imperfection.

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[1] Rice, canned tomatoes, hot cereal, chunk cheddar cheese, canned tuna, salt, imitation maple syrup, pancake mix, peanut butter, dishwashing detergent, toilet soap, toilet tissue, liquid shampoo, and canned dog food.

I may, however, be wrong, and I hope Dr. Pritchard will undertake to present, full-scale, his own concrete concept of effective competition.

STEPHEN H. SOSNICK
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Reference

[1] "What's Happened to Truth-in-Packaging?" *Consumer Reports* 34:40–44, January 1969.

QUADRATIC PROGRAMMING SOLUTION OF COMPETITIVE EQUILIBRIUM FOR U.S. AGRICULTURE: COMMENT

The authors Hall, Heady, and Plessner make these comments in the final section of their article [1, p. 551]: "This equilibrium study is only the first phase of a larger study. . . . Our aim is toward the rather long period required to make models of this type completely operational . . . We hope, as work progresses, to incorporate improvements in both the data and the model."

Their present reports seems to be premature, however, and the empirical results misleading. Publication of the article might be justified by its potential usefulness as a classroom exercise in econometrics, but why pretend or imply reality when so little is actually present? We have no particular quarrel with the objectives or model used in the study. This comment is rather a plea for reality in empirical applications and results. If an article's value is largely in its methodological content, that ought to be made clear to even the most casual reader.

It appears to us that the authors did not conduct an adequate inspection and evaluation of the results of the computer optimization. If so, how did they rationalize:

(1) the magnitude of the differences in farm prices reported for the several consumption regions of Table 3, and

(2) the apparent difference between 1965 actual and optimal soybean yields of approximately 67 percent?

It seems entirely fair to ask, too, how three economist authors and several probable reviewers could have permitted the following statement to stand, namely: "This special treatment of cotton was necessary because cotton lint is not a final product, and, thus, there are no demand functions for cotton" [1, p. 541]. Of course there are demand functions for cotton—cotton growers have sold cotton for many years at various prices! We have no objection to the deletion of cotton from the analysis, but the stated reason for doing so is improper and unacceptable.

With respect now to question (1) above, a case in point: Wheat for food use is shown in Table 3 to have a farm price of $0.48 in region 8, and $1.02 in region 9. Regions 8 and 9 are adjacent to each other. The difference in prices is $0.54 per bushel—what ordinary mode of transportation would involve rates anywhere near that level? Or is the optimum solution in violation of restraint II. 5. [1, p. 540], which requires that prices in any two regions cannot differ by more than the costs of transferring the grain from one to the other?

Question (2) relates to some of the data of Tables 2 and 4. Soybean acreage actually harvested in 1965 was 34,450,000 acres (Table 4), and actual U.S. demand for soybean oilmeal, including exports, was 13,450,000 tons (Table 2). This is an apparent gross yield of 0.390 tons of soybean oilmeal per acre. The same calculations applied to the estimated 1965 optimal solution implies a yield of about 0.652 tons of oilmeal per acre, an increase over the actual yield of about 67 percent. Are we to infer that land available for crop production is presently that poorly allocated to the production of the field crops included in the model?

These two specific references to the empirical results of the Hall, Heady, and Plessner study illustrate our point: That within the profession there may have developed a predilection to substitute methodology, models, and computers for good economic rationale, and to ascribe to them powers beyond their limited, mechanical capacities to aid in the analysis of data. Analysis should not end with the computer read-out. Computer solutions ought to be inspected closely for their adherence to reality as well as to the mathematical assumptions and restrictions of the model.

It is not easy to visualize how a comprehensive general equilibrium model of the crop or livestock-crop economy could be developed to the degree necessary to evaluate adequately the probable effects of alternative policies. The quantitative detail necessary to approach reality; the complex interrelationships in production, processing, and distribution; and the heterogeneity of products and factors critically limit the usefulness of any such complex model for policy purposes. The departures from reality necessary to make the model operational can, and in this case apparently did, yield results which, if followed by farm policy decision-makers, would be seriously misleading.

BLAIR J. SMITH
JOSEPH C. PURCELL
Georgia Experiment Station

Reference

[1] HALL, HARRY H., EARL O. HEADY, AND YAKIR PLESSNER, "Quadratic Programming Solution of Competitive Equilibrium for U.S. Agriculture," *Am. J. Agr. Econ.* 50:536–555, Aug. 1968.

QUADRATIC PROGRAMMING SOLUTION OF COMPETITIVE EQUILIBRIUM FOR U.S. AGRICULTURE: REPLY

The comment of Messrs. Smith and Purcell may be regarded as consisting of two objections: first, it questions the usefulness of employing quantitative models in economic analysis because of their "... limited, mechanical capacities to aid in the analysis of data." This, *vis a vis* the immense complexity of the real-world structure to which such econometric models are applied. Secondly, the comment questions the likelihood of some specific results presented in our article.

With regard to the first point, there is nothing novel in observing that the real-world complexities do not diminish if one does *not* use simplifying quantitative models. This does not imply, of course, that results read off the computer printer can, or should, be implemented, at least not before they are carefully screened. This, however, is not the issue. The judgment on the value of a publication such as ours is not (or should not) be a function of the precision with which the model reflects reality. It is a function of the extent to which the application of the model contributes to the understanding of real-world phenomena and processes. It also depends upon the usefullness of the model as a means of enhancing the effectiveness of "good economic rationale." This last role is fulfilled precisely by the simplifying nature of models. For even the most brilliant mind cannot simultaneously analyze the entire spectrum of events and causes present in the real world.

In addition, we fully recognize that an application of our model will be "mature" and exhibit its full capacity only after a considerable refinement of the data used and the assumptions employed. This, however, is no reason for withholding from the profession the information on the progress made so far. Of no less importance than the actual results obtained at this stage of the research is the potential usefulness of the approach. Our article makes this very clear.

Considering the specific questions of the comment's authors, the answers in both cases lie with the data. The difference in wheat prices in regions 8 and 9 is $.54. The transportation cost between these regions is $.84. This results from our assumption that demand and supply in each region are concentrated in one point in space. The use of historical average freight rates, rather than our normative rates, might have been preferable.

As for soybean meal, our *normative* data indicate a range of yields per acre from .28 tons (region 70) to .90 tons (region 134) [see map in 1, p. 545]. A yield of .65 tons falls well within this range. We might add that the arithmetic mean of yields in all regions is .56 tons. Apart from the explanation, we want to emphasize that a deviation of 67% of the programmed yield from its actual counterpart is not, *per se*, a reason for rejecting the results. First, the results also indicate an accompanying drop of 33% in price. This would constitute a major incentive for concentrating production in relatively high-yield regions. Secondly, the imposition of perfect competition on the system is itself a major deviation from the real-world situation, and is thus liable to produce some major deviations in specifics.

Finally, we did not intend to imply that ". . . there are no demand functions for cotton." What we did mean is that, since cotton is an intermediate good utilized in numerous and very different final goods, no satisfactory estimates of demand functions for cotton are available. We agree that the wording of our statement leaves something to be desired.

We hope that our present reply makes quite clear what should and what should not be attributed to our model. We hope that in the near future we shall be able to present a more detailed description of possible uses of the model in the formulation of policy.

We are not completely "immune" to the real world. We did not include livestock either, but we were not assuming that these products had "no demand." The same is true for grapes, oranges, apples and other commodities not included in the model and calculations. We were largely making a methodological illustration and application in this report. We believe that we emphasized this fact amply, although we did put more statements to this effect in a longer initial draft of the report, shortened to meet space requirements. In our article, we indicated that the report was one phase of a larger study. We have found it extremely difficult and complex to get a computer program which is applicable for large problems. At the time we write this, we are still after the "bugs" which restrain us on large models. If Smith and Purcell rush to our aid with armloads of coefficients, including demand functions, and computer programs that both work satisfactorily, we can soon get solutions to extremely extended models. In the meantime, we must slave away at the very large task of assembling and synthesizing sufficient data and improving computer programs that will allow us to get solutions of medium-sized problems. As soon as we complete this step, we shall turn to larger and more complete models. Still, we wish they would rush to our aid with the data and the efficient algorithm. In the meantime, we believe our first numerical application suggests the utility of such models and our first stage efforts.

HARRY H. HALL
EARL O. HEADY
Iowa State University
YAKIR PLESSNER
Hebrew University of Jerusalem

Reference

[1] HALL, HARRY H., EARL O. HEADY, AND YAKIR PLESSNER, "Quadratic Programming Solution of Competitive Equilibrium for U.S. Agriculture," *Am. J. Agr. Econ.* 50:536–55, Aug. 1968.

Reviews are listed alphabetically by authors.

Reviews

Butterwick, Michael, and Edmund Neville Rolf, *Food, Farming and the Common Market,* London, The Oxford University Press, 1968, xiv + 259 pp. ($7.75)

This volume is an assessment of differences in conditions and policies in the U.K. and the EEC and the effect on the U.K. that will follow from entry into the EEC. "The general objective of the book is to bring together, for the benefit of interested people in the U.K. and the community, information about food and farm policy, farming, and the ancillary trades and industries, here and in the EEC" (p. xi). This objective is followed. A great deal of information is presented, and it is aimed at an audience that has a degree of pre-acquaintance with European policies and conditions. In the relatively short space of 219 pages, the authors cover (1) formulation of EEC and U.K. policy (Chapters 1 and 2); (2) the impact of U.K. membership as it would influence balance of payments, retail food prices, U.K. trade in agricultural products, the cost of five categories of farm inputs, prices, and incomes, the future of marketing boards, agricultural cooperatives and ancillary trades and industries (Chapter 3); (3) both negotiations in Brussells (Chapter 4); and (4) the situation for 12 different commodities or commodity groups (Chapter 5 through 16). Doing this means that they have not used much space to lay out background conditions or the detailed workings of existing agricultural policy. As a result, some readers on this side of the ocean, at least, will be left wondering about such things as what the British standard quantity system is and how it operates, and what is involved in the French system of Producer Groups and Agricultural Economic Committees. Though gaps of this kind will exist for some readers, it is not a criticism of the book. The authors clearly did not intend to write a volume that covers all of U.K. and EEC agricultural policy.

The study is an investigation of the political-economic interrelationships involved in adapting U.K. policy to EEC policy. In some cases, exhaustive detail is presented on items that are not normally of central importance in agricultural policy while other apparently more important items are covered with a great deal less detail. As an example, the chapter on pigmeat covers only 5 pages while that on eggs covers 21 pages. In part this reflects the amount of information available, but it is also a reflection of differences in the complexity of the issues that will have to be faced in negotiation and in adaptation by the U.K.

While much data is introduced throughout the volume, there are very few tables included in the text and no precise quantitative projections will embarrass the authors in the future. When quantitative estimates of change in price or other variables are made, the authors either content themselves with quoting other persons or with stating their own estimates as general orders of magnitude. Despite this lack of precision in their quantitative analysis, it is apparent that they have a considerable degree of insight into the economic consequence of joining the EEC. Further, the book conveys some of the political subtleties inherent in this kind of change, both in relation to domestic British agriculture and in relation to bargaining with the EEC.

The book has one weakness: the authors don't tie the details of their analysis together. No chapter summaries are included, nor is there a summary chapter. The reader, thus, is left with much information and analysis but without a clear general picture of the probable effects of U.K. entry into the EEC. For this reason also, the book will be more useful to persons who have some acquaintance with European conditions and want more information on the specific issues and problems involved. This will include, in addition to Europeans on both sides of the channel, many persons in other countries who have a direct research, trading, or policy interest in the effects of enlarging the EEC.

VERNON L. SORENSON
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Doll, John P., V. J. Rhodes, and J. G. West, *Economics of Agricultural Production, Markets and Policy*, Homewood, Illinois, Richard D. Irwin, Inc., 1968, xiii + 557 pp. ($8.50)

Each time a principles of agricultural economics book is published, those who teach introductory courses, probably like me, hope it will be just right for the introductory course. This is not that book. As the authors state in the preface, their book "treats some of the more important parts of agricultural economics at the next level past principles."

However, some needs in an introductory text seem relevant to this review. An introductory text should above all improve the economic literacy of its readers who are majors in production departments, agricultural economics departments and even in departments outside colleges of agriculture. To accomplish this, it must provide a vivid and accurate description of the role of agriculture in an economy (state, nation, world) and to demonstrate the relevance and application of economic principles to problems of agricultural production, marketing, and consumption. It must be simple and empirical enough to interest the most traditional production-oriented student, yet analytical enough to provide an effective building block for the pre-professional economist.

Although that standard is most difficult to achieve, *Economics of Agricultural Production, Markets, and Policy* fits the standard well. However, it cannot be used as an introductory text because, as the authors state, it presents information at an intermediate level and emphasizes economic theory. Most comprehensive principles courses are offered at the introductory level, not at the intermediate level. It will be a useful text only in departments that emphasize preparation of undergraduates for graduate study and offer a comprehensive intermediate agricultural economic theory course. Unfortunately, because of the organization of course offerings, the effectiveness of this well done text will be largely restricted in undergraduate teaching to use as a theoretical supplement to specialized texts in farm management, marketing, and policy. Perhaps its publication will encourage departments to offer a general course for advanced undergraduate agricultural economics majors and for non-major graduate students in either general economics or other agricultural fields.

The beginning graduate student who has had very little economics, or one who needs a comprehensive review of theory early in a graduate program, should find it most useful. I know of no other modern single source review that so fully covers the field of agricultural economics.

The book is particularly well written and edited, which should increase its acceptability among discerning students. Its general organization is good, except that material in the last chapter would, have greater relevance near the beginning of the book. It would enable students to see the usefulness of theory in solving economic problems in agriculture before they study theories. I wish the authors, all of whom I know have a high level of social consciousness and responsiveness, had let these traits influence their book more. It was difficult to identify the subject matter as concerning human behavior. We have the opportunity, and I believe the responsibility, to integrate the ever increasing understanding of human behavior into presentations of economic literature. For a comprehensive text, it seemed to overemphasize micro production theory relative to macro theory, consumption theory and institutional problems.

Overall, the book is an excellent synthesis of what is known about agricultural economics. Its contents resemble an outline for a graduate program of study. Economics is so concerned with human problems that such a comprehensive text probably should be more "people-oriented." But that is not a criticism of this book alone. Rather, it merely reflects that social scientists for some time have so busied themselves with developing analytical tools that little energy remains to consider human involvements. This, of course, would have required original work, which the authors disclaimed as an objective.

JOHN SJO
Kansas State University

Heady, Earl O., *A Primer on Food, Agriculture and Public Policy*, New York, Random House, 1967, viii + 177 pp. ($4.95)

A great deal has been written recently concerning the population explosion and the impending food crisis, as well as governmental policy affecting agriculture. This book represents another literary effort to capitalize on subjects that have proven capable of arousing public interest.

The author begins the book with a basic discussion of the role of food in the world's economy and the problems encountered by the agricultural segments in various stages of development. Past governmental policies and programs with respect to agriculture are cursorily reviewed. Policies are classified as to whether they have been developmental or basically compensatory and regulatory in nature. The serious conflict between simultaneous compensatory and developmental policies is emphasized. Reasons for the nation's failure to resolve these conflicts are enumerated.

The author lists goals that he believes should prevail for future agricultural policy. He then outlines policy alternatives to accomplish those goals for two groups of rural residents: those who must leave and those who will stay. The book ends with a discourse on the so-called world food crisis and potential roles of the United States in alleviating the crisis.

The author's stated objective was to write a book for the student and citizen rather than the professional economist. Although a worthy goal, it appears, in this case, to have been a rather elusive one. The student interested in a precise accounting of past legislation affecting agriculture will need to look elsewhere, whereas the untutored citizen will certainly have trouble grasping presentations of rather technical concepts such as price and income elasticity.

It is questionable if Mr. John Q. Citizen will feel inspired to read further after encountering sentences such as the following (p. 149):

> "A long-term program should provide for a gradual shift to more complete reliance on the pricing mechanism in resource allocation and allow diversion of some Treasury outlays to other public services and welfare needs that arise with a larger population, greater per capita income, and increased leisure time."

Students complying with assigned readings may repeat such sentences the number of times necessary to grasp the ideas presented. Laymen are not likely to have the patience.

There is little in the book that is new or unique. However, there are some points with which one might disagree. Subject to question is the somewhat arbitrary selection of a dollar income level below which rural people are automatically branded as poverty stricken folk who *must* move elsewhere. There are many people with annual money income considerably below $5,000 who, by their own standards, have ample food, clothing, and shelter. In at least one mountainous region, many so determined "poverty stricken" families have the financial means of acquiring the mechanical conveniences that they are pitied for not having. They simply have a greater preference for savings. How much beyond adequate nutrition, clothing, and shelter must families have before they can escape this poverty classification?

Many farmers who fit into the author's category of those who by decree must go have not yet been reached by the technical aid the government has in theory been providing rural residents for over half a century. It is possible that the long run welfare of the people as individuals and the nation as a whole would be best served by an effective program that enables unskilled individuals to remain in their native habitats and retain some feeling of usefulness to communities. Such a program would seem infinitely more beneficial than programs that result in further crowding of "surplus human resources" onto the welfare rolls in the ghettos of cities to which displaced unskilled rural residents migrate. Government retraining schools teaching skills of hair dressing and tractor driving have not as yet materially altered this course.

Although the author states that a gradual shift to more complete reliance on the pricing mechanism in resource allocation offers the best hope for the future, his policies for those who remain on farms manifest little faith in this technique as a means of attaining production adjustment. At a time when the effective demand for agricultural commodities in developing countries is increasing, it is discouraging to see domestic producers withdraw further from these markets by seeking higher support prices for their products in order to get a "fair return." The government, at the same time, must offer more lucrative payments to farmers to induce acreage retirement to defer the tremendously profitable agricultural production that such "fair prices" generate.

The suggestion, in view of the "impending world food crisis," of opening the gates and allowing American farmers to produce to capacity at current domestic price levels is frightening. It makes as much sense as asking residents in a flooded area of the Mississippi Valley to increase the water supply by operating their pumps because there are areas in West Texas that are suffering from severe drought.

There are areas today where any gain in food supply is quickly consumed by increased population growth. By extrapolating such growth rates, some people are quickly led to the conclusion, just as Malthus was, that humanity faces world wide starvation within a calculated period of time. Overlooked is the simple fact that population cannot grow at such astronomical rates unless additional food is first provided. It seems folly to worry about food crisis the author predicts in three decades when it is basically starvation *now* that is keeping population growth in check in high growth potential countries, just as it has throughout most of recorded history.

Perhaps the author's concern for starving humanity is not as misdated as his predictions would indicate. In the closing passages of the book, he places a severe indictment on all people of financial means when he states (p. 162):

> "Murdering well-fed people is really no worse than allowing masses of people to suffer and perhaps die from insufficient food and health facilities."

Most of us have some capacity for preventing this kind of suffering and death.

GENE D. SULLIVAN
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McPherson, W. W., ed., *Economic Development of Tropical Agriculture—Theory, Policy, Strategy and Organization*, Gainesville, University of Florida Press, 1968, xvi + 328 pp. ($8.50)

The reviewer of a collection of essays faces an enormously difficult task because the frontage covered is usually broad and the merit of the individual essays cannot be adequately evaluated or even summarized in a sentence or short paragraph. This collection is no exception! It consists of fifteen essays by eleven authors, inclusive of the editor's introduction.

The implicit purpose of most collections is (a) to assemble scattered works bearing on some issue or set of issues not adequately covered by an existing monograph, or (b) to fill voids in the literature by inviting original contributions on a specifically identified subject. Both are needed. But the purpose of this volume is by no means clear. Examination of the content suggests that the title's clues to the organizational scheme are more an *ex poste* classification of the contents than an attempt to fulfill one of the above objectives by systematic selection of contributors and topics. To this reviewer, they do not comprise a very coherent whole. The term "tropical" in the title could be as aptly applied to almost any of the standard works on economic development, the general idea content of this book being, without obvious exception, as relevant to Tibet as to Tanzania, or to Korea as to the Congo. The fact that a majority of the empirical materials are taken from tropical areas is irrelevant, because the developmental problems peculiar to agriculture in tropical areas are scarcely mentioned, much less analyzed.

The above comments are meant to imply neither that the individual contributions are valueless nor that all of the contributions are unrelated. On the contrary, five of the essays, involving about 120 pages, would have made a useful small symposium on agricultural developmental planning and organization, especially if a brief introduction and summary had been added. Two essays by Arthur Gaitskill draw insightfully upon his vast experience and knowledge of the historical background in subSahara Africa and India, and Pakistan (Indus Basin), and two by James W. Green are on the closely related areas of development organization and advising on development organization. These, plus a general treatment by J. Price Gittinger of "Planning Characteristics of Low-Income Agriculture," provide useful perspectives on the interrelationships that must be taken into account when the specialist is sorting out relevant issues and analytical approaches in his own field. However, despite the coherency suggested by the "Theory, Policy, Strategy . . ." terms in the title, the remainder of the collection is best described as miscellany, albeit high quality miscellany in some instances.

Evidence to the above point is found in the character of two essays immediately following the editor's introduction. The "Theory" component of the book is supplied by John C. H. Fei and Alpha Chiang in a pure theory paper on "The Fundamental Cause of Economic Stagnation," which is supplemented by a five-page mathematical appendix. Its stated purpose is to explore the proposition that "when static technology subject to the law of diminishing returns is coupled with persistent population pressure (constant rates of increase), economic stagnation is bound to result." It has no special connection with agriculture, except by way of a cursory reference to Ricardian rent theory, and no conceptual connective tissue is built between this proposition and any of the other essays. This is followed by a largely common-sense level review of "The Importance of Agriculture in Economic Development," by Arthur Gaitskill, mainly restating the points covered in earlier works by such people as W. D. Nicholls [4] and Mellor and Johnston [3].

Earl O. Heady's paper mainly restates his rather "comfortable" position. He says (p. 59), "The knowledge is already at hand, theoretically and practically, in explaining the economic development of agriculture." To students of agricultural development, this is familiar doctrine. It serves in this book mainly to sharpen the implications of the orthodox methodological point-of-view, as it applies to agricultural development, and to contrast them with the implications of the point-of-view implicit in the papers on planning and explicit in the paper by Richard King on product markets. This latter point-of-view would seem to be based on (a) the assumed unity of problems as investigational units and (b) the corollary research objectives of the identification and evaluation of available alternatives in the situation. In this context, King suggests that the perfect market concept is perhaps one of our most useful conceptual tools.

Glenn Johnson's paper follows and distinguishes between structure and operation of factor markets, respectively, on the basis of (a) public policy and institutions and (b) (implicitly) everything else that marketing researchers study, including competitive structure. He mainly observes, without firm performance tests or even explicit criteria, that factor markets in Nigeria work quite well, but that in many respects policies of taxation, export levies, and the like, have adversely affected incentives for productivity-increasing innovations and resource allocations. He provides interesting glimpses of several policy problems. But in trying to cover the entire frontage of land, credit, purchased input and labor markets, nothing was (or could be) treated rigorously.

The remainder of the book consists of a recasting and condensation of Vernon Ruttan's (and S. C. Hsieh's) useful Stanford Food Research Institute paper [2] on "Environmental, Technological and Institutional Factors in the Growth of Rice Production . . ." (data on Taiwan removed), a paper on dynamic linear programming applications to less-developed areas by Max Langham, the concluding paper by Arthur Coutu on the role of United States universities abroad, and a paper on "Trade Preferences and Developing Countries" by Harry G. Johnson, formerly published in *Lloyds Bank Review*. The last is probably the most useful single article in the collection, because it touches on an area relatively little studied and in which agricultural economists are typically a bit short of training.

This collection will provide some worthwhile reference material for inclusion in institutional libraries. While, on balance, it can hardly be regarded as a substitute for the earlier collections prepared by Eicher and Witt [1] and by Southworth and Johnston [5] with their more coherent organization and more pointed definition of issues, several of the papers will be distinctly useful in courses on agricultural development.

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[4] NICHOLLS, WILLIAM H., "The Place of Agriculture in Economic Development," in *Economic Development with Special Reference to East Asia*, ed. Kenneth Berrill, International Economic Association, 1963 (reprinted in [1]).
[5] SOUTHWORTH, HERMAN M., AND BRUCE F. JOHNSTON, *Agricultural Development and Economic Growth*, Ithaca, Cornell University Press, 1967.

Schickele, Rainer, *Agrarian Revolution and Economic Progress: A Primer for Development*, New York, Frederick A. Praeger, Inc., 1968, xix + 410 pp. ($15.00)

"Development" is popular these days and it is inevitable that, amidst a literature that is burgeoning, a good deal of recapitulating will take place, some of it not overly productive. This title is a case in point.

It is the second book published by Praeger for the Agricultural Development Council, Inc. The first was *Getting Agriculture Moving: Essentials for Development and Modernization*, a popularization intended to persuade decision-makers in low-income countries to pay more attention to agriculture. Modesty was the keynote. Nothing new, the Preface confessed, is contained in this book. "Only the organization of the materials, and a few of the implications for agricultural development drawn from widely known facts and ideas, are original contributions of the author."

Apparently a need was felt for Mr. Schickele to carry the art of organizing and implying to its logical next stage; the essentials mastered, our decision-makers are now ready for a good, solid primer. This is all the more unfortunate because Mr. Schickele is a man of no small international experience, having among other things, served for twelve years as head of FAO's Land and Water Development Division and more recently in Peradeniya as an Agricultural Development Council Visiting Professor. Without a doubt he has much to contribute, but instead he finds himself in a position where he is obliged to try to say all superficially.

Mr. Schickele writes well and he knows that if he's going to get his message across he had better get us interested right at the beginning. And what better way to do this than by starting off with a discussion of the world food problem. "Produce or perish," he advises. We are interested, but not terribly enlightened.

There follow two chapters which are useful. Mr. Schickele has a conscience, a welfare economist in the proper sense, and he reminds us of the limitations of the market place as a guide for decision making and of the limitations of the conventional criteria for gauging economic progress. Nothing new, to be sure, but it warrants re-emphasizing from time to time.

The respite is brief. In the remainder (and bulk) of the book, Mr. Schickele attempts to strike a positive note and, by summarizing the collected wisdom on hastening rural development, to suggest that the world agricultural outlook is far from grim. The result is disappointing. The common denominators that emerge from the distilling process are so common as to come dangerously near to insulting the reader's intelligence. A Minister of Finance, with money to spend? No problem, Excellency. Simply turn to Chapter 7 and hear of schools, roads, and marketing facilities. A dull and listless peasantry? Relax. Land reform is clearly in order. Chapter 8 contains several prescriptions. Or perhaps your problem is wide open spaces, crying for the plowman. That's a tougher one, says Chapter 9, but if the Gezira succeeded, so can you.

And so it goes—not quite, of course, but just about—for over 400 pages.

The great majority of decision-makers abroad are neither dull nor uninformed. Like the people they serve, they are keen, in a hurry, and, above all, aware of their limitations. Advice and guidance they seek, but more than the threadbare maxims of twenty years ago—especially at fifteen dollars a copy.

THOMAS T. POLEMAN
Cornell University

CORRECTION

In the review of Daniel I. Padberg's *Economics of Feed Retailing* [*Am. J. Agr. Econ.* 50:1072–1074, Nov. 1968], the publisher was incorrectly cited as Cornell University Press. Inquiries relative to this book should be addressed to its actual publisher, the Food Distribution Program, Cornell University, 248 Warren Hall, Ithaca, New York 14850.

Books for listing in this section should be sent to the Book Review Editor (see inside front cover for address).

Books Received

Aragona, Gabriele Gaetani, *Direttrici dello Sviluppo Economico della Lucania, Schema di Sviluppo Agricolo ed Extra Agricolo della Lucania 1966–1981,* Bari, Arti Grafiche Laterza, 1967, 221 pp. Price unknown. Paper.

Aranda, Sergio, *La Revolución Agraria en Cuba,* Mexico D. F., Siglo xxi Editores, S. A., 1968, vii + 240 pp. Price unknown. Paper.

Arthur, Henry B., James P. Houck and George L. Beckford, *Tropical Agribusiness Structures and Adjustments—Bananas,* Boston, Division of Research, Harvard Business School, 1968, xi + 210 pp. $12.00.

Brannon, Russell H., *The Agricultural Development of Uruguay—Problems of Government Policy,* New York, Frederick A. Praeger, 1968, xxxvii + 367 pp. $15.00.

Brinegar, George K. and Lyle P. Fettig, *Some Measures of the Quality of Agricultural Credit,* National Bureau of Economic Research Inc., Technical Paper 19, New York, Columbia University Press, 1968, xii + 52 pp. $2.25 paper.

Davis, Robert K., with contributions by Robert M. Steinberg, Leo J. Hetling, and Nicholas C. Matalas, *The Range of Choice in Water Management—A Study of Dissolved Oxygen in the Potomac Estuary,* Baltimore, The Johns Hopkins Press for Resources for the Future, 1968, xviii + 196 pp. $7.00.

Dooley, Peter C., *Retail Oligopoly: An Empirical Study of the Structure, Conduct, and Performance of the Grocery Trade on the Prairies,* Studies of the Royal Commission on Consumer Problems and Inflation, Supporting Study No. 3, Regina, Saskatchewan, Queen's Printer, 1968, viii + 154 pp. $2.00 paper.

Dunbier, Roger, *The Sonoran Desert—Its Geography, Economy, and People,* Tucson, The University of Arizona Press, 1968, xiii + 426 pp. $10.00.

Goodhart, C. A. E., *The New York Money Market and the Finance of Trade, 1900–1913,* Cambridge, Harvard University Press, 1969, 235 pp. $6.50.

FAO Commodity Review, 1968,

Rome, Food and Agriculture Organization of the United Nations, 1968, $3.50 or 28 s paper.

Fertilizers, An Annual Review of World Production, Consumption and Trade, 1966, Rome, Food and Agriculture Organization of the United Nations, 1967, viii + 223 pp. $4.00 or 20s paper.

Fertilizers, An Annual Review of World Production, Consumption and Trade, 1967, Rome, Food and Agriculture Organization of the United Nations, 1968, viii + 211 pp. $3.50 or 28s paper.

Fitchen, John, *The New World Dutch Barn: A Study of its Characteristics, Its Structural System, and Its Probable Erectional Procedures,* Syracuse, Syracuse University Press, 1968, xviii + 178 pp. $12.50.

Gechtman, Murray and James Hardesty, *Arithmetic—Concepts and Skills,* New York, The Macmillan Company, 1968, viii + 312 pp. Price unknown.

Haveman, Robert H. and John V. Krutilla, with the assistance of Robert M. Steinberg, *Unemployment, Idle Capacity, and the Evaluation of Public Expenditures: National and Regional Analyses,* Baltimore, The Johns Hopkins Press for Resources for the Future, 1968, x + 159 pp. $6.50.

Junk, Paul E., Robert W. Paterson, Brackston Hinchey and Lonnie Nickles, *Personal Income for Missouri Counties, 1950–1965,* Columbia, University of Missouri, 1968, 277 pp. $3.50 paper.

Kitson, G. W., *Fresh Vegetable Retialing in New Zealand: An Economic Survey,* Agricultural Economics Research Unit, Research Report No. 50, University of Canterbury, New Zealand, 1968, 45 pp. Price unknown. Paper.

Kneese, Allen V., and Blair T. Bower, *Managing Water Quality: Economics, Technology, Institutions,* Baltimore, The Johns Hopkins Press for Resources for the Future, 1968 x + 328 pp. $8.95.

Koo, Anthony Y. C., *The Role of Land Reform in Economic Development: A Case Study of Taiwan,* New York, Frederick A. Praeger, 1968, xvii + 197 pp.

Kuhnen, Frithjof, *Agriculture and Beginning Industrialization: West Pakistan, Socio-Economic Investigations in Five Pakistan Villages,* Publications of the German Orient Institute, No. 21005, Opladen, C. W. Leske Verlag, 1968, 274 pp. 29 DM paper.

Mangalam, J. J., with the assistance of Cornelia Morgan, *Human Migration —A Guide to Migration Literature in English, 1955–1962,* Lexington, University of Kentucky Press, 1968, 194 pp. $15.00.

Massell, Benton F., and R. W. M. Johnson, *Economics of Smallholder Farming in Rhodesia—A Cross-Section Analysis of Two Areas,* Food Research Institute Studies Supplement to Vol. VIII, Stanford University, 1968, 74 pp. $4.00 paper.

Mellor, John W., Thomas F. Weaver, Uma J. Lele, Sheldon R. Simon, *Developing Rural India—Plan and Practice,* Ithaca, Cornell University Press, 1968, xxi + 411 pp. $10.00.

Misra, R. P., *Diffusion of Agricultural Innovations,* Mysore, University of Mysore, 1968, xiii + 208 pp. $4.00.

Neutze, Max, *The Suburban Apartment Boom,* Baltimore, The Johns Hopkins Press for Resources for the Future, 1958, xii + 170 pp. $5.00 paper.

Production Yearbook, 1967, Rome, Food and Agricultural Organization of the United Nations, 1968, xvi + 784 pp. $9.00 or 72s or FF 45.

Saikia, P. D., *Changes in Mikir Society, A Case Study of Kanther Terang Village, Mikir Hills, Assam,* Jorhat, Assam, Agro-Economic Research Centre for North East India, 1968, xv + 82 pp. Rs 8 paper.

Sally, H. L., *Irrigation Planning for Intensive Cultivation,* New York, Asia Publishing House, 1968, xvii + 208 pp. $7.25.

Shim, Young Kun, *Household Consumption Patterns of Food Grains in Suwon, A Report of Field Survey, Winter 1966–1967,* Suwon, Korea, Seoul National University, 1967, 75 pp. Price unknown. Paper.

Shim, Young Kun, *Marketing of Rice and Other Grains in Suwon, Report of a Field Survey, 1965–1967,* Suwon, Korea, Seoul National University, 1968, 94 pp. Price unknown. Paper.

The State of Food and Agriculture, 1968, Rome, Food and Agriculture Organization of the United Nations, 1968, viii + 205 pp. $5.75 or 46s paper

Tisdell, Clement Allan, *The Theory of Price Uncertainty, Production and Profit* Princeton, Princeton University Press, 1968, ix + 197 pp. $6.50.

Whyte, R. O., *Grass-Lands of the Monsoon,* New York, Frederick A. Praeger, 1968, 325 pp. $9.50.

World Grain Statistics, 1966-67, Exports by Source and Destination, Rome, Food and Agricultural Organization of the United Nations, 1968, 77 pp. $1.50 or 12s or FF 7.50 paper.

Zarkovich, S. S., *Quality of Statistical Data,* Rome, Food and Agriculture Organization of the United Nations, 1966 xi + 395 pp. $6.00 or 30s paper.

Announcements

ANNUAL MEETING
AMERICAN AGRICULTURAL ECONOMICS ASSOCIATION

August 17–20, 1969, Lexington, Kentucky

Preliminary Outline of Program
(Complete program will be distributed by letter)

Saturday, August 16
9:00 Executive Board meeting

Sunday, August 17
1:30 Executive Board meeting
7:30 Reception

Monday, August 18
9:00 The Place of Agricultural Economics in the Economy of Today, ————————————

Presidential Address, Dale E. Hathaway

1:20

A	B	C	D
Economics of Inputs	Toward Better Undergraduate Teaching	Experiences in Rural Economic Development	Vignettes: Tools of our Trade

1:20 A Economics of Inputs
Structure of Input Supplying Industries, Dale C. Dahl, University of Minnesota
Concepts of Finance Capital for a Capital-Using Agriculture, Chester B. Baker and John A. Hopkin, University of Illinois
National Labor Relations Legislation: Possible Impact on American Agriculture, ————————————

1:20 B Toward Better Undergraduate Teaching
Chairman: B. F. Stanton, Cornell University

1:20 C Experiences in Rural Economic Development
Gleanings from Rehabilitating a Region: The Ozarks. Lloyd D. Bender, USDA and University of Missouri, and Bernal Green, USDA and University of Arkansas

A Generation of Experience in the Great Plains, ______ ______

A Few Years' Experience in Appalachia, ______

Discussants: ______

1:20 D Vignettes: Tools of our Trade

3:30

E	F	H	I	J
Vignettes: Tools of our Trade	Vignettes: Keeping our House in order	Vignettes: Empirical Studies	Vignettes: Demonstrations	Vignettes: Policy

6:00 Agricultural Industry Dinner
8:00 An Evening with a Fellow
9:00 Plans for 1970 Meeting of International Association of Agricultural Economists

TUESDAY, AUGUST 19

8:30

The Organization of Agriculture Chairman: Marshall Harris, Univ. of Iowa	Economics of Resource Use of Development Chairman: ______ ______	Policy and Non-Policy in Foreign Trade Chairman: ______ ______
Constants and Variables in Comparative Systems, Folke Dovring, Univ. of Illinois	Technical Change in Development: The U.S. and Japanese Experience, ______	New Concepts and Tactics in Foreign Trade Negotiation, ______
Economies and Diseconomies of Large Scale Agriculture, Philip M. Raup, Univ. of Minnesota	Natural Resources and Economic Growth, ______ ______	Technology vs. Neo-Mercantilism in International Trade, ______ ______
Discussants: ______ ______	Externalities and their Effects on Resource Allocations and Welfare, ______	Discussants: ______ ______

10:45 Annual Business Meeting, American Agricultural Economics Association
12:00 Ladies' luncheon

1:20

J	K	L	M
Content and Technique in Education on Policy	The Farm and the Law	Inducing Economic Development in LDCs	Tools of our Trade: Analytical Techniques Applicable to Domestic Development

1:20 J Content and Technique in Education on Policy
Chairman: J. Carroll Bottum, Purdue University
Basic Framework for Policy Education, J. B. Kohlmeyer, Purdue University
Discussants: ______________________

3:30

N	O	P	Q	R
Economics of Outdoor Recreation	Meaning of Conglomerate Business	Tools of our Trade: Farm Management	Vignettes: Empirical Studies	Vignettes: Tools for Policy

5:15 Barbecue
8:00 Awards program

WEDNESDAY, AUGUST 20
8:30 Educational Institutions in Today's World, ______________________
9:15 The Meaning to University Instruction; The CEANAR Report, ______
____
9:30 The Meaning to Research and Extension, ______________________
10:00 Agriculture in the Economy of the Future
Institutional Obsolescence and Innovation in American Agriculture, Restatement of article published in May AJAE, James D. Shaffer, Michigan State University
10:10 Discussants: (to be selected from contributed papers)
10:30 Panel
Moderator: ______________________
Members: Shaffer, Dovring, Raup, ______________________
General notes: papers for a number of sessions, including the vignettes, will combine invited and contributed papers; Student Section program not shown herein.

SUPPLEMENTARY NOTE ON CONTRIBUTED PAPERS 1969 AAEA ANNUAL MEETING

Plans for presenting contributed papers are being modified this year. As in previous years, several sectional meetings are planned where selected contributed papers will be presented. But it is not intended that the presentation of contributed papers will be limited to special sessions. Where a paper fits into the topic of another planned session, it may be included along wth regularly invited papers. This applies to papers that have been submitted *before May 1, 1969.*

AAEA EMPLOYMENT SERVICE

The AAEA Employment Committee will provide services to assist the following groups during the annual meeting on August 17–20, 1969, at the University of Kentucky:

a. Employers seeking staff
b. Individuals seeking employment

Two separate forms for job applications will be used. One is oriented toward the needs of students completing their graduate programs. The second form is designed primarily for professionals in government, academic, and business positions and will be identified by code number. This latter form is briefer and lends itself toward more anonymity than does the former.

The appropriate forms as well as additional information will be sent to all AAEA members in June and also to a number of academic, government, and business employers who may choose to use the service.

Individuals or organizations who are not members of the AAEA may obtain forms from:

LOYS L. MATHER
AAEA Employment Committee
Department of Agricultural Economics
University of Kentucky
Lexington, Kentucky 40506

ANNUAL MEETING
WESTERN AGRICULTURAL ECONOMICS ASSOCIATION

The 1969 annual meeting of the Western Agricultural Economics Association will be held at Oregon State University, Corvallis, July 20–23.

Russell Youmans, chairman of local arrangements, is sending WAEA members detailed information about the meeting.

Following is a brief summary of the program:

SUNDAY, JULY 20

Afternoon Council meeting
Evening Reception

MONDAY, JULY 21

Forenoon "Western Agricultural Economics in the 1970's"
Questions of relevance and future directions of our teaching, extension and research programs; our relationships with industry; and the WAEA.

Afternoon Contributed Papers Sections
Titles and abstracts of papers to be considered should be sent to the sectional chairmen listed below by June 1:

Commercial Agriculture

Dr. E. R. Barmettler
Division of Agricultural Economics & Education
University of Nevada
Reno, Nevada 89507

Natural Resource Development

Dr. Norman E. Landgren
Department of Economics
Colorado State University
Fort Collins, Colorado 80521

Community and Human Resource Development

Dr. James C. Barron
Department of Agricultural Economics
Washington State University
Pullman, Washington 99163

Evening Salmon bake

TUESDAY, JULY 22

Forenoon "Agricultural Policy"

The latest from Washington, D.C.; social and political dilemma of the agricultural sector and agricultural institutions; the consumers' role in the agricultural coalition.

Annual business meeting

Noon WAEA Luncheon

Presentation of awards; installation of 1969–70 officers; brief speech of general interest.

Afternoon "International Development and Trade"

Developments in agricultural production in high-change countries; interactions among food supply, population, technology and development; developments in international trade.

"Regional Analysis and Economic Development"

Problems and opportunities in domestic economic development; rural and urban poverty; reports on regional and area development research; report on work in marine economics; report on extension program in community resource development.

WEDNESDAY, JULY 23

One or more educational tours arranged by the Oregon State University staff.

INTERNATIONAL ASSOCIATION OF AGRICULTURAL ECONOMISTS 1970 CONFERENCE: CONTRIBUTED PAPERS

Papers on topics in any field of agricultural economics will be accepted; however, papers on (1) "Risks and Uncertainties: How to Take Them into Account in Farm Planning" and (2) "The Econometric Study of Supply Determinants" are especially invited.

In choosing papers for presentation at the Conference, the selection committee will give preference to those having the following characteristics:

1. Papers having relevance in a world context.
2. Papers presenting new and original approaches to problems rather than reviews of the existing literature.
3. Papers likely to provoke or stimulate discussion at an international conference session.
4. Papers on topics not covered at other sessions of the Conference. (Details of the draft program may be secured from country correspondents.)

Papers must be in the hands of the Chairman of the Committee,

Professor K. O. Campbell
Department of Agricultural Economics
University of Sydney
Sydney, N.S.W. 2006
Australia

not later than January 15, 1970. (The Conference meets August 24 to September 2, 1970.)

Papers should be in English and not exceed 3,000 words (including text, footnotes, tables, and charts). Manuscripts should be typewritten (black ribbon), single-spaced, using one side of plain white paper. Recent issues of the *Proceedings* of the Association should be used as a guide.

(The above is briefed from the announcement of the Executive Committee. Further inquiries or requests for the complete announcement should be addressed to Professor Campbell or to country correspondents. U. S. members may contact Joseph Ackerman, Farm Foundation, 600 South Michigan Avenue, Chicago, Illinois 60605, or K. L. Robinson at Cornell.)

NEW DEAL AGRICULTURE BIBLIOGRAPHY

The Agricultural History Branch of the U.S. Department of Agriculture and the Agricultural History Center at the Davis Campus of the University of California are cooperating to compile, in sections, a comprehensive bibliography of American agricultural history. Recently published is "A Preliminary List of References for the History of American Agriculture During the New Deal Period, 1932–1940," compiled by Harry C. McDean. The list is available upon request to the Agricultural History Center, University of California, Davis, California 95616. Other bibliographies also available on request are those for California, the Granger Movement, and the Pacific Northwest and Alaska.

AAEA DUES

Dues for 1969 are payable. The dues rates are as follows:

Regular membership	$10.00
Junior membership (graduate students, 3-year maximum)	5.00

Please mail your check, payable to the American Agricultural Economics Association or AAEA, to C. D. Kearl, Secretary-Treasurer, AAEA, Department of Agricultural Economics, Cornell University, Ithaca, New York 14850.

WESTERN AGRICULTURAL ECONOMICS ASSOCIATION

The annual dues rates are as follows:

Regular membership	$3.50
Student membership (with student status certified by department)	1.00

Mail application and check to Leo R. Gray, Secretary-Treasurer, WAEA, Post Office Box 89, Berkeley, California 94701

SOUTHERN AGRICULTURAL ECONOMICS ASSOCIATION

Annual membership dues (includes proceedings issue of SJAE)	$3.00

Direct correspondence concerning membership to John C. Redman, Secretary-Treasurer, SAEA, Department of Agricultural Economics, University of Kentucky, Lexington, Kentucky 40506.

CANADIAN AGRICULTURAL ECONOMICS SOCIETY

Annual membership fees	(Can.) $10.00

Mail fees to Treasurer, CAES, Box 632, Postal Station B, Ottawa, Ontario, Canada.

News Notes

AGRICULTURAL DEVELOPMENT COUNCIL

APPOINTMENTS: **William L. Collier**, Ph.D. Hawaii, Agricultural Economic Survey, Indonesia Ministry of Agriculture, Bogor, Indonesia; **Donald C. Taylor**, formerly of American University of Beirut, visiting professor (2 years), Mysore University of Agriculture Sciences, Bangalore, India.

ECONOMIC RESEARCH SERVICE, USDA

(EDD is Economic Development Division; ESAD is Economic and Statistical Analysis Division; FDTD is Foreign Development and Trade Division; FPED is Farm Production Economics Division; FRAD is Foreign Regional Analysis Division; MED is Marketing Economics Division.)

APPOINTMENTS: **Patrick P. Boles**, MED at Columbus; **Charles P. Butler**, FPED at Clemson, as coordinator of newly formed Regional Technical Committee for Cooperative Regional Research Project S-67; **Raymond Christensen**, Director (formerly Deputy Director), FDTD; **Edward V. Jesse**, MED at Madison; **William T. Manley**, Acting Director (formerly Deputy Director), MED; **Levi A. Powell, Sr.**, Assistant to Director, MED; **Roger Wilsie**, Portland, Oregon.

TRANSFERS: Robert W. Bohall, MED, from North Carolina State University to Washington, D.C.; **Rex F. Daly**, from Chairman, Outlook and Situation Board, to Director, ESAD; **Lawrence Davidoff**, from FDTD to Assistant Agricultural Attache, FAS, Bonn, West Germany; **Kenneth R. Farrell**, from Director, MED, to Acting Assistant Administrator, ERS, and Chairman, Outlook and Situation Board; **Warren R. Grant**, FPED, from College Station, Texas, to Davis, California; **Ronald E. Kampe**, from FRAD to EDD as Assistant Chief, Area Analysis Branch; **J. B. Penn**, FPED, from Baton Rouge, Louisiana, to Lafayette, Indiana; **W. Neill Schaller**, from FPED to International Agricultural Development Service.

LEAVE: **Stanley S. Johnson**, FPED, returned from 2-year assignment with Rice Research Institute, Philippine Islands.

RESIGNATIONS: **Arthur F. Bordeaux, Jr.**, MED, to University of Kentucky; **Anne E. Hammill**, NRED, to economist with Federal Reserve Board, Washington, D.C.

RETIREMENTS: **Edgar B. Hurd**, FPED, after 39 years of Federal service; **John H. (Dixie) Southern**, Director, EDD, after 33 years of Federal service, to head Ford Foundation program in Nepal.

IOWA STATE UNIVERSITY

APPOINTMENTS: **Walter W. Haessel, Gerald A. Harrison,** and **Arthur I. Stoecker,** research associates, Department of Economics.

UNIVERSITY OF MANITOBA

APPOINTMENT: **Norman J. Beaton,** Ph.D. Kansas State, assistant professor.

LEAVE: **Sol. Sinclair,** returned as professor and appointed Director, Natural Resources Institute, after 2 years as Head, Development Planning Division, Kenya Ministry of Agriculture.

UNIVERSITY OF NEBRASKA

APPOINTMENTS: **Douglas Genereux,** M.S. Nebraska, assistant to Campus Coordinator of International Programs; **Allen C. Wellman,** assistant professor.

LEAVE: **Loyd K. Fischer,** returned as professor after 2 years in Bogota, Colombia.

UNIVERSITY OF NEW HAMPSHIRE

APPOINTMENTS: **Edmund Jansen,** formerly with University of North Carolina, and **Sherrill B. Nott,** Ph.D. Cornell, to faculty in resource economics.

NORTH CAROLINA STATE UNIVERSITY

APPOINTMENTS: **Jimmie Bruce Bullock** and **Gerald A. Carlson,** assistant professors.

LEAVE: **Richard A. King,** University of California, Berkeley (6 months).

TEXAS A&M UNIVERSITY

LEAVE: **Charles Baker,** rejoined staff after 2 years in Dominican Republic.

RETIREMENT: **Clifton H. Bates,** as farm management specialist since 1946.

UNIVERSITY OF WISCONSIN

APPOINTMENT: **Richard Hilliker,** Ph.D. Wisconsin, assistant professor.

LEAVE: **Bernard Erven,** returned as professor after 2-year assignment with Wisconsin-AID program, University of Rio Grande do Sul, Porto Alegre, Brazil.

OTHER APPOINTMENTS

Galen Blomster, Ph.D. Purdue, National Cash Register Company, Dayton, Ohio.
Lon C. Cesal, Purdue-AID project at Rural University, Minas Gerais, Brazil.
Jeane Chen, M.S. Nebraska, State Labor Department, Lincoln, Nebraska.
Robert Leon Coppersmith, visiting lecturer, University of Missouri.
Eduardo de la Espriella, Esso Standard Oil Company, Costa Rica.
Geoffrey Ferster, Ph.D. Cornell, staff, University Dar Es Salam, Tanzania.
Melvin From, M.S. Nebraska, Omaha National Bank, Omaha.
Yaaqov Goldschmidt, Ph.D. Cornell, economist, Inter Kibbutz Economic Advisory Unit, and faculty, Graduate School of Business Administration, Tel Aviv University.
Bengt S. Gustafsson, Ph.D. Purdue, research leader in agricultural economics, Farm Structures Research Institute, Lund, Sweden.

John Holmes, M.S. Nebraska, Ralston Purina Company, Newberg, Oregon.

John Hyslop, M.S. Missouri, manager of farm operation, Bennett Wholesale, Inc. Bloomfield, Missouri.

H. Bruce Huff, Ph.D. Michigan State, assistant professor, University of Guelph.

Kazumi Kobayashi, Ph.D. Cornell, faculty, Kyoto Szngyo University.

M. L. Lerohl, editor, Canadian Journal of Agricultural Economics.

Patrick Lubischer, M.S. Nebraska, Pathfinder Company, Fremont, Nebraska.

James C. Martin, Ph.D. Missouri, associate professor, Murray State University, Murray, Kentucky.

Gordon A. MacEachern, formerly of Purdue, President, Agricultural Economics Research Council of Canada.

Marcelo Peinado, Ph.D. Wisconsin, assistant professor, Utah State.

Al Reiners, M.S. Nebraska, Bureau of Reclamation, Boise, Idaho.

L. S. Venkataramanan, formerly visiting professor, Minnesota, Head, Division of Agricultural Economics, Indian Agricultural Research Institute, Pusa, India.

Moshe Weiss, Ph.D. Cornell, research section, Sun Oil Company, Philadelphia.

James G. Yoho, formerly of Duke University, Head, Department of Forestry, Mississippi State University.

AWARD

Clifton B. Cox, group vice president, Armour Foods, and a director, Armour & Company, honorary Doctor of Science degree, Auburn University.

OBITUARIES

Bushrod W. Allin, chairman of USDA's Outlook and Situation Board for nearly 20 years, died November 18 of pneumonia in Washington, D.C. Dr. Allin had retired in 1965, after receiving the USDA Distinguished Service Award—the Department's highest distinction—for his outstanding leadership in developing and coordinating the USDA agricultural outlook services as a practical aid to farmers and agribusinessmen. He was president of the American Farm Economics Association in 1962 and was elected a Fellow of the Association in 1965.

Dr. Allin was noted as a skillful writer and effective speaker, as well as a leading economist. He co-authored several books, as well as articles for the *Journal of Farm Economics,* the *Encyclopaedia Britannica,* and numerous bulletins, speeches and reports.

He was born on a farm near Harrodsburg, Kentucky, on August 28, 1899. He grew up in Texas, served in the Army during World War I, and was graduated from the University of Wisconsin in 1921 with a B.S. in agriculture.

Dr. Allin worked two years for USDA as a farm cost accountant before returning to Wisconsin, where he earned his Ph.D. in 1928. After that, he returned to the USDA and advanced rapidly through the ranks of economists in the Bureau of Agricultural Economics. He headed the Bureau's Division of State and Local Planning from 1938 to 1942.

Walter Henry Pierce, Professor Emeritus of Economics at North Carolina State University, died on November 9, 1968, in Raleigh, North Carolina, at the age of 52. He had retired on April 1 with over 22 years of service with the Department of Economics.

Dr. Pierce received the B.S. degree in agricultural economics from N.C. State in 1936 and his M.S. in 1948 and his Ph.D. in 1953 from the University of Minnesota. He was employed as assistant farm management specialist with the North Carolina Agricultural Extension Service until October, 1938. He transferred to the USDA (BAE), Division of State and Local Planning until May 21, 1941, when he was called to active duty in connection with World War II. Since his release from active duty in 1945 as a Lt. Colonel, Dr. Pierce had been involved in teaching and research in various fields of agricultural economics at North Carolina State University. He authored or co-authored more than 75 publications during his career.

DOCTORAL DEGREES CONFERRED IN AGRICULTURAL ECONOMICS, 1968

Mani Ali Afifi, B.S. Ain Shams University, 1960; M.S. University of California, 1964; Ph.D. University of Hawaii, *An Econometric Study of the Competitive Position of Hawaii Broiler Industry.*

Saleh Afiff, Drs. University of Indonesia, 1959; M.B.A. University of California, 1961; Ph.D. Oregon State University, *Food Supply and Economic Development in Indonesia, Problems and Prospects.*

Donald E. Anderson, B.S. North Dakota State University, 1953; M.S. North Dakota State University, 1957; Ph.D. University of Minnesota, *The Impact of the Commodity Credit Corporation on the Structures of Grain Markets in the North Central Region.*

Peter Laurence Arcus, B.Ag.Sc. Massey University, 1960; M.Ag.Sc. Massey University, 1964; Ph.D. Iowa State University, *Projections of Farm Employment in the United States through 1980.*

Virach Arromdee, B.S. Chulalongkorn University, 1950; M.A. University of Wisconsin, 1957; Ph.D. University of Minnesota, *Economics of Rice Trade Among Countries of South East Asia.*

Luciana E. Barraza-Allande, B.S. Escuela Nacional De Agricultura, 1962; M.S. University of Wisconsin, 1966; Ph.D. University of Wisconsin, *A Three Sectoral Model of Growth for Mexico.*

Albert Wayne Bartholomew, B.S. California State Polytechnic College, 1963; M.S. Cornell University, 1965; Ph.D. Cornell University, *Costs of United States Price and Income Support Programs for Wheat, Feed Grains, Cotton, and Dairy Products, 1954–65.*

Larry Lee Bauer, B.S University of Illinois, 1961; M.S. Purdue University, 1963; Ph.D. North Carolina State University, *The Effect of Technology on the Farm Labor Market.*

Ujagar Singh Bawa, B.A. Khalsa College, 1948; M.A. Punjab University, 1953; A.M. University of Pennsylvania, 1962; Ph.D. Cornell University, *The Relationships Between Agricultural Production and Industrial Capital Formation in India, 1951–52 to 1964–65.*

Mujibur R. Bhuiyah, B.A. University of Dacca, 1956; M.A. University of Dacca, 1957; Ph.D. Michigan State University, *Improved Planning and Changing Strategies for Agricultural Development in East Pakistan.*

Arlo Biere, B.A. University of Nebraska, 1963; M.A. University of California, 1967; Ph.D. University of California, *River Basin Management With Particular Reference to the Salinas Basin.*

Kalman Blum, Diploma, Institut National Agronomique, 1953; M.A. University of California, 1967; Ph.D. University of California, *On Explaining Productivity Change in United States Agriculture.*

Arthur Franklin Bordeaux, B.S. North Carolina State University, 1962; M.S. North Carolina State University, 1965; Ph.D. Michigan State University, *Resource Productiivty and Returns in Apple and Cherry Production on Michigan Farms.*

Don Bostwick, B.S. University of Wyoming 1953; M.S. North Dakota Agriculture College 1955; Ph.D. Montana State University, *Agricultural Resource Allocation in the Cauca Valley of Colombia.*

Donald William Boyd, B.S. 1961, M.S. 1963, B.S. (2d) 1965, Ph.D. Montana State University, *Simulation Via Time-Partitioned Linear Programming: A Ground and Surface Water Allocation Model for the Gallatin Valley of Montana.*

Garnett Lowell Bradford, B.S. 1957, M.S. 1959, University of Kentucky; Ph.D. North Carolina State University, *An Economic Analysis of the Costs of Producing Flue-Cured Tobacco and Cost-Production Variable Relationships.*

Russell H. Brannon, B.S. Oklahoma State University, 1954; M.A. George Washington University, 1958; M.S. University of Wisconsin, 1965; Ph.D. University of Wisconsin, *The Role of the State in the Agricultural Stagnation of Uruguay.*

Richard W. Bruce, B.S. Washington State University, 1957; M.A. Washington State University, 1959; Ph.D. Washington State University, *Competitive Structure of Lumber Markets in the West.*

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Shifts in Entrepreneurial Functions in Agriculture*

MARSHALL HARRIS

Substantial elements of entrepreneurship in agriculture are being shifted to off-farm firms and government agencies. These shifts involve public programs that control land use and guide its development and that take private land for public purpose. In the private sector, they include substitution of corporate enterprise for family farming, restrictions on freedom of action under credit arrangements, control over tenant-operated farms, direction of management under vertical coordination contracts, and control of farmer cooperatives and bargaining associations over buying and selling. In the future, family farming may be under pressure to meet technological requirements, and corporation farming may offer competition. In the absence of a massive support program, the family farmer may continue to shift elements of entrepreneurship to off-farm firms. An important question is: What is happening to farmer entrepreneurship under the impact of modern technology and urbanization?

MANY farm operators are transferring important elements of entrepreneurship to off-farm businesses and governmental agencies. Such entrepreneurial shifts are a part of the structural revolution in today's agriculture. They frequently are so subtle that they are overlooked among more obvious technological innovations. Separation of ownership, management, and labor is taking place at an increasing tempo. Concurrent technological and structural revolutions perhaps will become known as the "Agricultural Revolution of the 20th Century." It may parallel the earlier Industrial Revolution in the nature and magnitude of changes in the organization and operation of production processes.

Shifts in entrepreneurial functions seem to be of such magnitude that resultant changes in the organizational structure of the farming industry need review. What is happening to entrepreneurship in farming? Some ideas about the magnitude of changes that are taking place are presented without any attempt to measure them precisely. The first task is one of gaining some insight into the nature of the shift of entrepreneurial functions.

The prime objective of this article is to illustrate an analytical framework within which the evolving structural organization of agriculture may be researched and understood more fully. Other objectives are to show (1) the relationship between the technological revolution and selected institutional arrangements in agriculture and (2) significant shifts in entre-

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* The views of the author do not necessarily represent those of the U.S. Department of Agriculture. The author is deeply indebted to his colleagues for many valuable suggestions.

MARSHALL HARRIS *is an economist with the Economic Research Service, USDA, and a research professor, Agricultural Law Center, University of Iowa.*

preneurship to off-farm firms (without trying to delineate means of measuring their magnitude), and to raise some questions that typify the kinds of research needed in the short run.

Background

Since its beginning, the nation has tried to create an environment in which many forms of farm organization would thrive. It has also tried to create an economy (with laissez-faire and free-enterprise as hallmarks) in which each farmer would have maximum freedom of choice consistent with maintenance of property rights and domestic tranquility. As a consequence, family farms, plantations, ranches, and part-time and part-retirement farms have thrived side by side.

The granting of land to settlers was still in process when family farms apparently needed special support and treatment. The U.S. Department of Agriculture, state agricultural experiment stations and extension services, vocational agricultural high schools, and special farm credit institutions were established to serve the needs of the numerous family-farm businesses. Unique privileges were granted farmer cooperatives to help put family farmers in a position to bargain effectively with growing corporate enterprise. Later, a varied group of programs was developed, ostensibly to bolster the integrity of family farming.

Signs of internal adjustments in the family-farm structure began to appear before family farms reached their maximum number. The unencumbered ownership objective of family farming became untenable with increasing land values and subdividing farm property caused by equal devolution. Mortgaged indebtedness and farm tenancy moved in at a rapid rate, especially in rich land areas of high capital requirements per farm. More recent adjustments in conditions under which farms are operated have been made by vertical coordination contracts, farming corporations, and government programs.

The present Agricultural Revolution is composed of two distinguishing characteristics: obvious technological changes, which make the headlines almost daily, and less-proclaimed structural changes, which are obscured in contractual provisions and unwritten rules of the game. Both the technological and the structural phases of the revolution are folowing patterns not unlike those of the Industrial Revolution. Questions that need to be answered include: What are the nature and consequences of current structural changes? Are they becoming so firmly established that meaningful adjustments will be difficult to effectuate in the future? How is the silent structural revolution affecting the farmer's control and management of his business? To what extent are entrepreneurial functions being shifted to off-farm firms? What is happening to the farmer as an entrepreneur?

Independent Farmer

Suppose we gauge entrepreneurship by the departure of current condition from some definable norm. Let us call this norm "independent farmer" and let him be a benchmark or polar extreme. This independent farmer holds fee simple ownership of all the farm real estate that he operates; his ownership is neither subject to reservations nor to encumbrance, such as easements, mortgage, rural zoning, or land-use regulations; he owns all of the capital resources (personal property) that he uses, also unencumbered; he furnishes all the labor (including family labor) necessary to operate his farm; he holds complete managerial control over his entire farming operation; he makes all organizational and operational decisions; his farm business is large enough to yield in a normal year all income needed by his family; and he bears all of the risks and losses and reaps all of the gains of the entire farm business.

Our independent farmer holds the most complete entrepreneurship conceivable. He holds all possible entrepreneurial functions regardless of the time, place, or type situation under observation. Although this concept is set up as a benchmark against which the present entrepreneurial situation in farming may be measured, researched, and evaluated, it is not suggested as a policy goal. It is designed to describe the maximum entrepreneurship that a farmer can hold, so that all departures may be measured as a diminution in entrepreneurship. Although the independent farmer is hypothetical, there are farmers today who approximate it, except for societal reservations.

An independent farmer coordinates his production with off-farm firms through open factor and product markets. The open market has many sellers of inputs and buyers of outputs. Both buyers and sellers are informed adequately of the market situation and both are free to buy and to sell. Any diminution in the open-market specifications would represent a departure from the freely competitive market-oriented economy upon which the efficacy of the independent-farmer benchmark heavily depends.

Entrepreneurship

Entrepreneurship consists of decisions and the association of consequences of these decisions. Entrepreneurship is management, with results of management directly linked to the manager. Entrepreneurs have an interest (a property) in the resources which they manage. Unlike a paid manager, the entrepreneur's return is a function not only of his decision making per se, but of his property interests. He thus manages property and production processes.

Through our conventional imputational procedures, we have some (even if weak) insights into the returns to property. We are far less certain about return to management of production. (Is management a factor of production?) We may sense that the attribute of correct choice making is valuable. We also sense that a wide range of choices makes fullest use of "a maker of correct decisions." The attribute of entrepreneurship is enhanced by a wider range of choice. Because entrepreneurial environments change over time, entrepreneurship can be viewed most usefully in terms of the proportion of all possible choices that are open to the entrepreneur. To this writer's knowledge, these entrepreneurial attributes have not yet been adequately quantified. A difficulty in evaluating a shift in entrepreneurship is measurement of a set of abstract yet definite rights that are bargained against a set of indefinite expectations [4, p. 277].

Entrepreneurship is evidenced by the farmer's rights and responsibilities, benefits and burdens, and rewards and risks in the business that he operates. Any subtraction from rights, benefits, or rewards represents a diminution in entrepreneurship, as defined here. Any addition to responsibilities, burdens, or risks correspondingly means a weakening of the entrepreneur's position.

Entrepreneurship can be analyzed largely in terms of the independent farmer, as defined. It can be assayed from several viewpoints: How does the entrepreneur gain access to resources? Who performs entrepreneurial functions? Who holds control? Who acts in decision making? How does the entrepreneur behave? What is happening to his claim on economic returns?

The quantity of entrepreneurship held by an independent farmer is the total of all entrepreneurial functions at a given time and situation. For example, a farmer who homesteaded a century ago could have held all entrepreneurship, excepts rights reserved by society, in his 160-acre homestead, although the amount of capital invested was negligible and management inputs were small indeed compared with today's requirements. Our concept of entrepreneurship does not presume absolutes. The main concern is with the freedom of the farmer to choose, regardless of the range in choice. The focus is on whether the farmer holds all entrepreneurship or part or all of it has been transferred to or assumed by off-farm entities or reserved under the sovereign power of society.[1]

Societal Reservations

The tendency is almost universal to think of fee simple ownership as full, complete, and absolute. Yet, over the years, society has reserved at least five rights in privately held land: the right to tax, the right to take for public purpose, the right to police, the right of escheat, and the spending power. These well-established societal rights can be used to reduce the rights or values of property and the choices in productive processes available to the farmer.[2]

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[1] No endeavor is made to present the evidence needed to properly evaluate what is happening. The shifted entrepreneurship may be much less valuable than the gain in economic growth, income, or status. If the shifts in entrepreneurship appear to be in the right direction after adequate study, they may need to be improved and expedited. A central thesis of this paper is that shifts in entrepreneurship should be analyzed and evaluated now, rather than after they become further institutionalized.

As society becomes more complex and integrated, group decisions based on one or more of these societal reservations increasingly set the bounds of individual action. Societal actions that reduce entrepreneurship of the farmer doubtlessly will be of increasing importance in the foreseeable future. Some societal actions, however, have increased the choices available to the farmer, for example, large public investments in agricultural research.

Property taxes may reduce entrepreneurship and do it unequally. A sovereign government need not tax farm real estate—the Federal government does not. Such taxes are becoming less important than formerly in many units of government. Nevertheless, taxes may affect entrepreneurship in the following ways: reduction in ownership through tax foreclosure; encouragement of exploitative use to meet fixed annual tax payments; imposition of unequal burdens because of inequities in assessments and levies, and because of special exemptions, e.g., homestead exemptions; adjustments in inventories to minimize taxes; modification of time of sale of products to meet fixed tax date; selection of relatively stable income enterprises to meet relatively stable (albeit increasing) tax payments; and reduction of capital available for development of resources, accumulation of capital, and family living.

One measure of the shift of this element of entrepreneurship is the amount or proportion of the annual net income taken by taxes. Property taxes in 1966 on farm real estate and personal property amounted to $2.1 billion, up from $1.5 billion in 1960. Property taxes in 1966 amounted to 11.6 percent of the $17.9 billion net income for agriculture [20, p. 7]. Thus, real and personal property taxes represent a substantial charge against the entrepreneur's claim to farm income.[3]

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[2] These societal reservations are not usually thought of in terms of reducing entrepreneurship of private landowners and operators. Yet, they do have such an impact. In discussing the conflict between public (social) and private (individual) rights, Dean Cribbet, College of Law, University of Illinois, suggested that "both private and public rights must give in an urbanizing society," and that "the legal tools are (a) police power, (b) eminent domain, and (c) taxation." (See *Proceedings of Rural Urban Fringe Conference,* Allerton House, Monticello, Illinois, November 9 and 10, 1967, p. 3).

[3] Between 1960 and 1966, the proportion of net farm income that went for taxes declined. This represents a decrease in entrepreneurship that was taken by taxes, which might indicate an increase in farmers' entrepreneurship between 1960 and 1966. The basic concern of this article, however, is not with shifts of this kind, although it does contain some ideas about them. The article is concerned exclusively with shifts in entrepreneurship from the specifications in the independent-farmer benchmark. Such shifts always represent a diminution in entrepreneurship, for the independent farmer, by definition, holds the maximum of entrepreneurship.

The taking by purchase of private property for public purpose eliminates completely an entrepreneur's use of the land; taking an easement only restricts his land use rights. Although detailed data are not available on the acreage or value of privately held farmland that may be taken for all public purposes, available data on future demands of the booming electrical transmission industry will furnish some insight. According to present plans (construction during 1968–75), 44,815 miles of new extra-high voltage transmission lines will reduce entrepreneurial rights in almost a million (986,820) acres of land [7, pp. 7–9]. The power of eminent domain doubtlessly will be exercised more frequently as population increases and urbanization and industrialization proceed.

The entrepreneur's right to use land as he chooses may be reduced by exercise of the police power. The police power is an inherent power of organized society to protect and encourage the public health, safety, morals, and general welfare. It is indefinable except in those terms. It is adaptable to the demands of new situations as they arise. Although all private land is subject to the police power at various levels of government, it is usually applied evenly to similarly situated farms. Rural zoning is one exercise of police power that affects agriculture.

Privately held land may become public land via escheat. This sovereign right merely fills the void when private ownership fails to supply a private owner. The incidence of escheat is small, for few landowners die without an heir.

The spending power of government is exercised in many programs that reduce entrepreneurship of the private landowner from that specified in the independent-farmer benchmark. The power of the purse is used to attain public policy objectives—for example, soil conservation, production control, and irrigation—that are not feasible under other reserved rights of the public in private lands.

The impingement of societal reservations upon a farmer's entrepreneurship may be beneficial—beneficial to society, as in property taxes, rural zoning, and public transportation, and to a particular farmer, as in soil conservation, irrigation development, and production control. Societal reservations are included here because they have an impact on the farmer's entrepreneurship. There is no suggestion that the use of societal reservations should be either increased or reduced. The *quid pro quo* aspect of the exercise of specific reservations, however, needs to be evaluated. Matters of equity become of increasing importance as the use of societal reservations expand.

Major Institutional Adjustments

Although societal reservations may continue to have an increasing impact on farmer entrepreneurship, greater changes probably will take place in institutional arrangements. Major adjustments may occur in form of organization, credit arrangements, lease agreements, production contracts, farmer cooperatives, and government programs.[4]

Form of organization

The independent-farmer benchmark is based on a sole proprietorship form of organization, in which the farmer may hold maximum entrepreneurship. Other conventional forms are: partnerships, in which entrepreneurship is usually divided among the partners; corporations, in which entrepreneurial functions may become widely diffused, failing grossly to meet the criteria of an independent farmer; and trusts, in which the trustee usually holds all farm and financial management control and may even dispose of the property, if the trust agreement so provides.

Most agricultural property is operated in sole proprietorships. Little information is available on farming corporations and the incidence of partnership and trust forms in agriculture is largely unknown. There probably are many partnerships in farming (for example, father-son partnerships). It is believed that the number of farm corporations has increased rapidly, particularly during the past decade. The Internal Revenue Service reports that there were 18,526 farming corporations in 1965 with business receipts of $4.9 billion, an average of $263,000 per corporation [22, p. 235]. In a survey of 22 states, Scofield and Coffman [18] found 6,700 corporations with agricutlural operations. These represented 0.7 percent of all commercial farms, and operated 6.8 percent of total acreage in all commercial farms [18, p. 10]. Data are not available on the use of farm trusts.

To understand the shift in entrepreneurship under the corporate structure, three types of farming corporations must be distinguished: (1) family farm corporations of the closely held Subchapter S type,[5] (2) large public corporations for farming only, and (3) large public corporations with the chief purpose of diversifying or reducing their income tax. When a family farm is incorporated, the operator can retain absolute control by owning over 50 percent of the voting stock. The farming corporation could place management control in one person, regardless of voting stock, but normally he would become a hired manager working under direction of the corporation, which would keep for itself many decisions, such as major policy formulation and disposition of the property. Although the corporate device permits a wide range in the allocation of entrepreneurial functions, some farms held by corporations and most farms held in trusts fail almost completely to meet the independent-farmer definition. Corporate and trust business forms generally represent the greatest departure from the independent-farmer benchmark. An exception may be the Subchapter S corporation.

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[4] Minor institutional arrangements that effect entrepreneurship include professional farm management service, social security, workmen's compensation, and minimum wages. Others may be specified in a more detailed analysis.

[5] A Subchapter S corporation is one that is taxed like a partnership, avoiding the double taxation feature of the Internal Revenue Code for regular corporations.

Credit arrangements

Many farmers fail to meet the entrepreneurial attribute of the independent farmer of no encumbrances on either real or personal property. In 1967, farm real-estate debt was $23.3 billion and nonreal-estate debt was $22.4 billion, an indebtedness of $45.7 billion, or 17.0 percent of the total value of both real and personal assets of $269.5 billion used in farming [20, p. 2]. Brake estimated that debt-asset ratio would increase from 15.8 percent in 1965 to 28.4 percent in 1980 [5, p. 1542]. Credit may be used effectively to increase the total quantity of resources controlled by the farmer, but entrepreneurship may be diluted by provisions in the mortgage agreement.

What does this mean? Although credit is useful in acquiring control over resources needed to increase farm income, the diversion of several billion dollars annually to pay for debt capital weakens significantly the independent-farmer characteristic of unencumbered real and personal property. The diversion could also deplete income on heavily encumbered farms to the place that some farms would not meet the needs-of-the-family characteristic of the independent farmer. Credit, however, is essential in modern agriculture and plays an important role in efficient use of resources.

Some lenders are increasingly interested in the use made of loaned capital; in particular, many local banks are furnishing financial management along with their loans. A recent study reveals that over half of the agricultural banks of the country employ an agricultural specialist. Increasingly, they are requiring annual farm financial statements and budget or cash flow statements, and an increasing proportion are providing credit life insurance with farm loans and computer service to selected farm customers [2, pp. 5, 17, and 18]. The Farmers Home Administration of the U.S. Department of Agriculture has had considerable experience with "supervised credit."

To summarize, in 1967 farm entrepreneurs failed by $45.7 billion to meet the criterion of unencumbered property ownership. The resulting necessity of meeting high fixed annual charges reduced the entrepreneur's managerial freedom on many farms. In addition, an increasing number of lenders exerted some guidance and direction over farm operations of their borrowers.

surements were developed and data gathered to test the compatibility of family-operated farms with rapid technological advance.

Family-Operated Farms

Farm businesses of all sizes, large and small, are becoming larger. Although the increases are moderate, they reflect drastic changes in the structural organization of our farm economy. Under present economic and technological conditions, farms have to (1) reach larger, more adequate business sizes, (2) depend more on nonfarm income of operators and their families, or (3) disappear from agriculture. All three developments are proceeding at a rapid rate in this period of readjustment.

A sample survey by the Bureau of the Census estimated that in 1965 about 79 percent of all farm marketings came from farms with $10,000 or more of sales. It estimated that about 60 percent of the total income of operators' families came from sources other than the farms they operated [10]. In 1965 there were also about 1.8 million fewer farms than in 1949 (croppers' farms were not counted as independent units) and the decrease consisted mainly of family-operated units. This massive disappearance of family farms and the increase in the nonfarm income of farm families induced two conceptual errors often heard. The first is to equate family farms with small-size farm businesses, and the second, as a logical consequence of the first, is to interpret the disappearance of small farms as heralding the doom of the family farm [3]. However, the critical question is not how many small farms are disappearing, but whether more of these small units are being replaced by adequately-sized-family farms than by larger-than-family farms.

A shift of family farm labor to nonfarm occupations is also sometimes cited as evidence of a decrease in the importance of family farms. Here again, the critical question is not how much operators and their families are increasing their nonfarm activities, but whether they operate whatever they continue to farm mostly with their own labor and management. The answer to this question may be obtained by examining the changes in the proportions of family farms to all farms and in their shares of total farm production. These changes are of special significance for adequate family farms with $10,000 or more sales.[2]

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[2] Adequate family farms are businesses with sufficient resources and productivity to yield enough farm income to provide for (a) expenses for family living; (b) farm expenses, including depreciation, maintenance of the livestock herd, equipment, land and buildings, and interest on borrowed capital; (c) enough capital growth for new farm investments required to keep in step with technological advance and rising levels of living. However, these are not the criteria by which adequate family farms were classified in this article. Here, family farms with $10,000 or more of sales were classified as adequate family farms. No implication was intended as to the efficiency of their production nor the adequacy of family income. It was recognized that family off-farm income often greatly contributes to the economic survival of a farm.

The salient facts of these changes are:

(1) Despite a marked reduction in the number of farms, the proportion that were family farms remained about the same from 1949 to 1964, and their share of marketings changed but little. In 1964, family-operated farms accounted for 95 percent of all farms and for 64 percent of the value of all products sold. In 1959, these proportions were 95 percent and 69 percent, respectively, and in 1949, 95 percent and 63 percent (Table 1).

(2) Family farms have been expanding rapidly in the hard core of our commercial agriculture—those units with $10,000 or more of sales, which today account for about 85 percent of total farm marketings. In 1964, there were 385,000 more family-operated farms with $10,000 or more of sales than in 1949. The adequate family farms accounted for 46 percent of total farm products sold in 1964, compared with only 21 percent in 1949. For the same period, the share of the total marketings of larger-than-family farms did not change. They accounted for 37 percent of all farm products sold in 1949 and for 36 percent in 1964 (Table 1; sales values in 1957–59 prices).

The economic importance of family farms varies greatly by states. Family farms are most dominant in the North Central part of the country, as well as in some of the Middle Atlantic and South Central states. In California, Texas, Florida, and a few other states on the other hand, family farms provide less than half of total farm sales (Figure 1).

Three observations may be made with respect to the regional differences:

(1) Family farms are most numerous where the mechanization of the farm production is at least as well developed as in any other part of the country. This indicates their compatibility with this kind of technological advance.

(2) In some types of farms, obtaining inputs, marketing, and processing have become so closely related to production that their organization is being readjusted to best coordinate these functions. Supplying inputs, marketing, and processing are stages of agricultural production more adapted to a concentration of capital, management, and labor than crop growing and animal production. As a result, these farms tend to develop into larger business sizes, and the patterns of organization found in nonfarm industries are becoming more prevalent. This is true of farms producing vegetables, fruits, eggs, and fed cattle—the leading products in California, Texas, Florida, and a few other states where family farms are less dominant. This suggests that regional differences are partly related to type of farming.

(3) However, there are also historical differences in the development of the structural organization of farming in these various regions. The family pattern of organization of the first colonists in the East and the

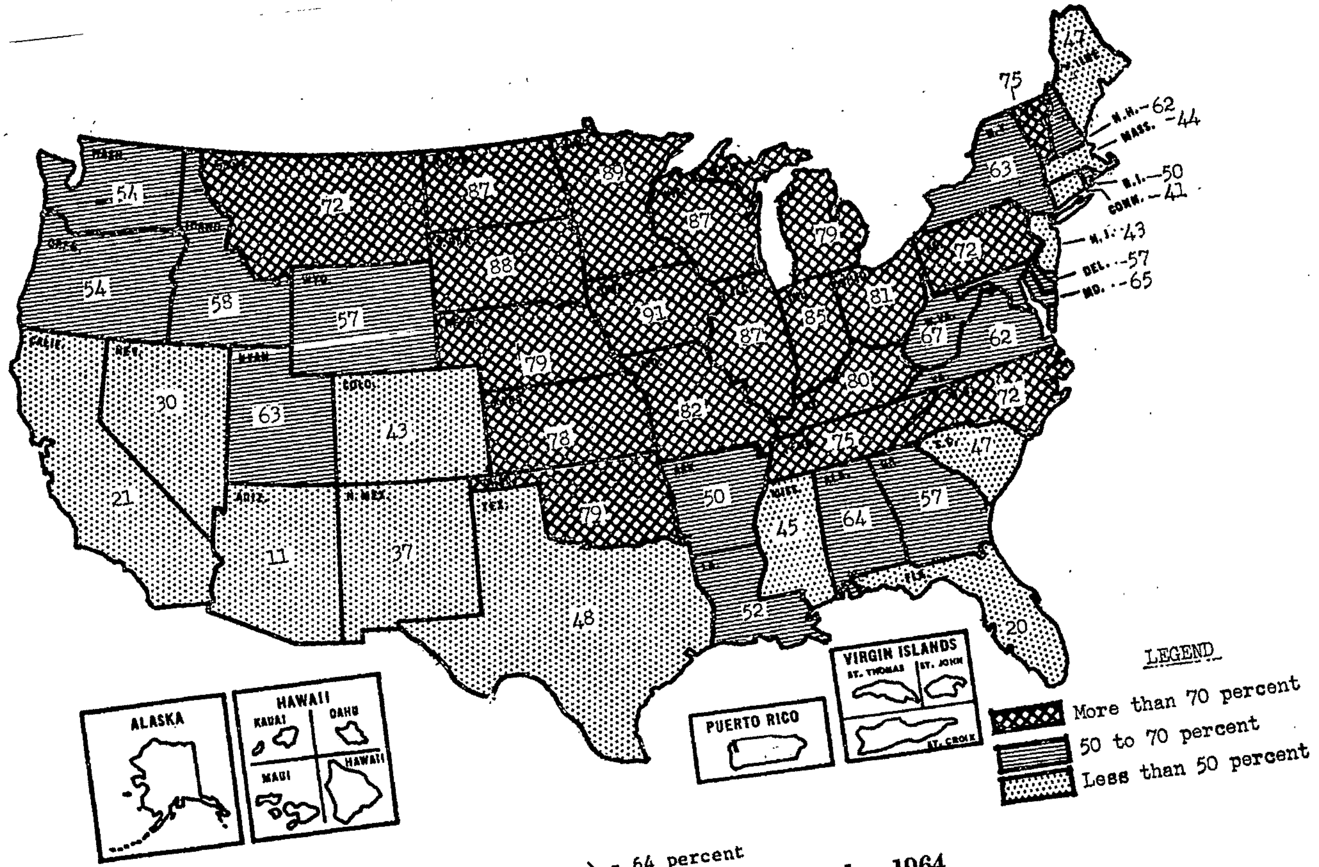
Table 1. Number and marketings of family farms as a percentage of all farms, United States, 1949, 1959, and 1964[a]

Value of annual sales and class of farm	Number of farms			Marketings			Percentage of all farms					
							Number			Marketings		
	1949[b]	1959	1964	1949[b]	1959	1964	1949	1959	1964	1949	1959	1964
	Thousand farms			*Million dollars*			*Percent*					
All farms	4,905	3,698	3,153	22,280	30,471	35,221	100	100	100	100	100	100
All family farms	4,641	3,530	2,996	14,030	21,136	22,648	95	95	95	63	69	64
Less than 10,000[c]	4,301	2,892	2,271	9,282	8,391	6,413	88	78	72	42	27	18
10,000 and over[c]	340	638	725	4,748	12,745	16,235	7	17	23	21	42	46

[a] Alaska and Hawaii not included.

[b] 1949 corrected for change in farm definition in 1959 census. Cropper farms not considered as independent units but as part of respective multiple-unit operations.

[c] For periods as far apart as 1949 and 1964, the $10,000 level probably does not represent the same size because of changes in costs and other characteristics of farming. It is a convenient way to indicate the general direction rather than a precise measure.



U. S. (48 states) - 64 percent

Figure 1. Sales by family farms as a percentage of total farm sales, 1964

"Homestead" family settlement of the Midwest still influence these parts of the country. In the same way, the plantation system in the South and the Spanish latifundia heritage in California, Arizona, New Mexico, Texas, and Florida may still be factors in these areas.

Self-Employed Family Labor in Farming

Further light is thrown on the predominant family characteristics in the organization of our farming by examining data on the use of family labor and hired labor.

A classification of farms by use of hired labor shows that family labor is predominant on a majority of American farms, including a considerable number of relatively large units. It shows also that the greater part of national food and fiber is produced by family labor (Table 2).

Because of the substitution of capital for labor, the labor used on farms has declined rapidly. Today, about 70 percent less labor is needed to produce 36 percent more food and fiber than at the end of World War II. The crucial question with regard to family farms is whether this substitution of capital for labor has displaced more family or more hired labor [4].

In the last decade the proportions of work done on farms by family labor and by hired labor have not changed much. An analysis based on the wage bill shows that these proportions were 68 percent and 32 percent, respectively, throughout the 1960's. Bureau of Labor Statistics data show a somewhat higher proportion of family work done on farms, 70–71 percent. In an estimate based on a special survey by the Bureau of the Census, this figure rose to 72 percent between March 1965 and March 1966. Family labor accounted for 61 percent of all work done on farms with $10,000 or more of sales in the same period [11].

The long-term predominance of self-employment in American farming has not been lessened significantly by recent economic, social, and technological changes. As shown in Table 3, the proportion of self-employment on farms has remained about the same since 1930. In the country as a whole, family labor accounted for 76 percent of total farm employment during 1930-39 and 75 percent in 1967.

The alleged aging of farm operators is often taken as a sign of the shrinking importance of family labor in farming. The fact is that when farmers who are self-employed entrepreneurs are compared with their counterparts in other occupations, little difference is found in their ages. Farmers on adequate farms, however, tend to be younger than self-employed persons in nonfarm occupations [5].

Self-employment in farming varies greatly by regions. The highest proportion of self-employment, more than 86 percent, is found in the East North Central and West North Central geographic divisions. The smallest

Table 2. Farms and farm sales by specified use of man-years of hired labor and by specified size and class of farms, United States, 1964

Man-years of hired labor	Percentage distribution of specified groups of farms									
	All		Large[a]		Medium[b]		Small[c]		Part-time[d]	
	Number	Sales	Number	Sales	Number	Sales	Number	Sales	Number	Sales
None	49.8	19.4	2.1	1.3	15.7	13.6	35.0	32.6	65.9	52.0
Less than 0.5	38.0	30.4	3.9	2.2	35.5	30.6	50.3	50.4	32.5	40.5
0.5–0.9	4.9	8.2	3.3	1.9	13.3	12.6	8.5	9.4	1.2	2.3
1.0–1.4	2.6	6.5	5.7	3.3	10.9	11.4	3.5	4.2	0.3	0.6
1.5–2.4	2.1	7.3	10.5	6.3	11.3	12.9	2.0	2.5	0.1	0.4
2.5–4.9	1.5	8.2	20.7	13.7	9.1	12.0	0.6	0.8		0.8
5.0–6.9	0.4	3.3	11.2	8.2	2.2	3.3	0.1	0.1		0.5
7.0–9.9	0.3	2.9	10.8	8.8	1.2	2.0	[e]			0.5
10.0–14.9	0.2	3.1	11.0	10.9	0.6	1.1				0.5
15.0 and over	0.2	10.7	20.8	43.4	0.2	0.5				1.9
All farms	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a] Farms with sales of $100,000 or more.

[b] Farms with sales of $20,000 to $99,999 inclusive.

[c] Farms with sales of $5,000 to $19,999 inclusive.

[d] Farms with sales of $5,000 or less.

[e] Blank spaces indicate less than 0.05 percent.

Source: Special tabulation, *U.S. Census of Agriculture, 1964.*

Table 3. Family labor as percentage of total farm employment, United States and geographic divisions, 1930–1967[a]

Year	United States	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific
1930–39	76	60	68	79	80	78	85	75	60	54
1940–49	77	70	71	84	84	79	84	71	62	53
1950–59	75	64	71	85	85	74	81	68	63	51
1960	74	61	73	85	85	71	79	63	62	49
1961	73	61	71	85	86	70	78	61	63	49
1962	73	62	74	85	85	70	78	61	64	50
1963	73	66	73	84	85	67	75	63	64	49
1964	74	67	74	85	86	68	77	64	64	50
1965	74	67	74	86	86	67	77	64	64	49
1966	74	67	76	87	86	67	76	68	63	47
1967	75	66	76	87	86	68	78	69	62	47

[a] Annual average of persons employed (including farm operators) during the last full calendar week ending at least one day before the end of each month. Alaska and Hawaii not included.

Source: U.S. Department of Agriculture, *Farm Labor*, SRS Crop Reporting Board, monthly issues.

and a decreasing proportion is found in California, Florida and Arizona, where family labor accounted in 1967 for only 36 percent, 31 percent, and 19 percent, respectively, of total farm labor. It should be noted that the decline in the proportion of self-employment in the southern part of the country was mostly due to a considerable decrease of croppers, who were classified as family labor. In the 1960's, when the outflow of croppers from farming in that region was about finished, the proportion of family labor again became stable (Table 3).

Operators' Management and Control of Production Resources

There is no available information that would permit a direct measurement of changes in the extent of operators' control over farm production resources, but general observations suggest that this control remains as strong as ever. However, continued control of farm operations and production resources does not mean that managerial functions are not changing. The following observations bear out these points.

Farms operated by paid managers

Since American farm production is primarily organized into family-operated farms, any reduction in operators' control would be reflected in an appreciable increase in the number and proportion of farms operated by paid managers. No such change has occurred. As a matter of fact, census data show a decrease between 1949 and 1964 in the number of farms with $2,500 or more of sales operated by paid managers, with no significant change in the proportion of all farms in that category. More important, it appears that the same is true for the proportion of managers' farms in all economic classes of farms, including the largest group with $100,000 or more of sales, where the corporate form is found (Table 4).

Farms operated by paid managers are heavily concentrated in Califor-

Table 4. Farms operated by paid managers by specified value of sales, and their percentage of all farms in each sales group, United States, 1949, 1954, 1959, and 1964

Value of sales	1949		1954		1959		1964	
	Number	Percent	Number	Percent	Number	Perber	Number	Percent
$100,000 or more	[a]				2,618	13.1	3,761	12.0
$40,000–$99,999					3,064	3.7	3,021	2.7
$20,000–$39,999					3,384	1.5	2,781	1.1
$10,000–$19,999					3,192	0.7	2,663	0.6
$10,000 or more	12,247	2.5	10,400	1.8	12,258	1.5	12,226	1.4
$5,000–$9,999	4,881	0.7	3,385	0.5	2,494	0.4	1,423	0.3
$2,500–$4,999	1,475	0.2	2,018	0.2	1,611	0.3	856	0.2
$2,500–$9,999	6,356	0.4	5,403	0.4	4,105	0.3	2,279	0.2
Total $2,500 or more	18,603	0.9	15,803	0.8	16,363	0.8	14,505	0.8

[a] Blank spaces show data not available.

Sources: *1954 U.S. Census of Agriculture,* Vol. II, Table 18. *1959 U.S. Census of Agriculture,* Vol. II, Ch. XI, Table 5. *1964 U.S. Census of Agriculture,* Vol. II, Ch. VI, Table 15.

nia and Florida and are of considerable economic importance in Arizona, Nevada, and Connecticut. In 1964 marketings by farms operated by paid managers accounted for 35.4 percent of all sales by commercial farms in Florida, 20.4 percent in California, 26.8 percent in Arizona, 26.0 percent in Nevada, and 23.1 percent in Connecticut. But these states, as already shown, were never the strongholds of family farms. On the contrary, larger-than-family farms were always of great economic importance. In the rest of the country, farms operated by paid managers are of much less importance. In the Corn Belt, for example, sales by farms under paid management accounted in 1964 for less than 3 percent of total farm marketings (Figure 2).

Land tenure

A significant expansion of large farm businesses, and their substitution for family farms, would be reflected in a considerable increase in the proportion of acreage operated under paid management. But no changes have been evident in traditional land tenure patterns in the United States.[3] Throughout the last two decades, from 1944 to 1964, the proportion of land operated by owners has been about 55 percent; by renters, 35 percent; and by paid managers, about 10 percent (Table 5).

In United States agriculture, farmers have traditionally owned most of the machinery needed in farm production and they continue to do so. Parsons [7] states that in 1956, "considering all farms in the United States,

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[3] We are speaking here of the tenure under which farmland is operated, disregarding the composition of operating units. Thus, for example, in a part-owner farm, part of the land is owned by the operator and part is rented.

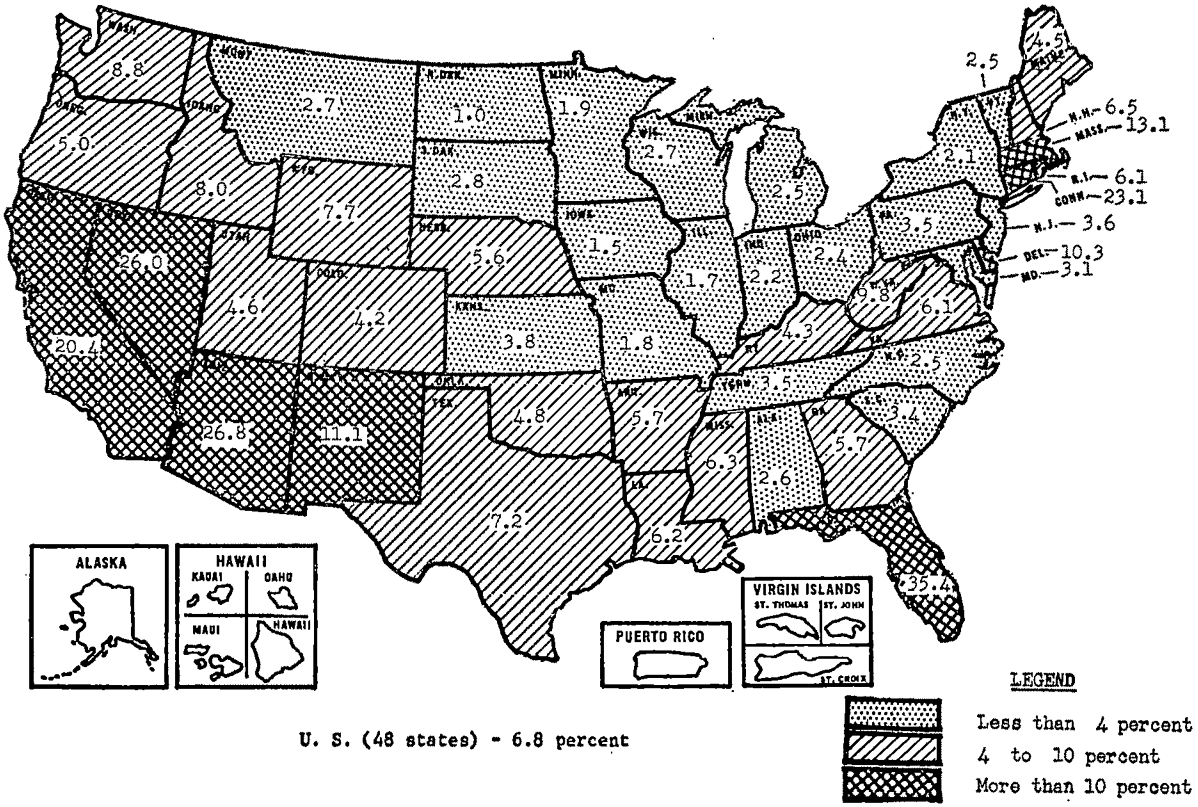

Figure 2. Sales by commercial farms operated by paid managers as percentage of sales by all commercial farms, 1964

Table 5. Tenure under which farmland is operated, United States, specified years, 1944–1964[a]

Year	Total farmland acreage	Farmland operated by[b]		
		Ownership	Rental	Paid management
	Million acres	Percent		
1944[c]	1,142	53	38	9
1949	1,161	56	35	9
1954[c]	1,160	57	35	9
1959	1,123	55	35	10
1964	1,110	54	36[d]	10

[a] Except for 1944, tenures were estimated by assuming that part-owners did not subrent their rented land.

[b] Computed before rounding numbers.

[c] Alaska and Hawaii not included.

[d] Estimated by subtracting acreages operated by owners and managers from total acreage.

Source: *1964 U.S. Census of Agriculture,* Vol. II, Chapter 8, Table 2, p. 754.

only a few machines, such as pickup haybalers, field forage harvesters, and power dusters, show independent ownership below 80 percent." For most other machines 90 percent or more were independently owned by farmers. In 1964, according to Strickler and Smith [9] "most of the cultivating of crops and land—94 percent—was done by farmers with their own equipment." Even in combining crops, where custom work was always most prevalent, farmers' own equipment continues to predominate. Of the 153 million acres that were combined in 1964, 72 percent were harvested with farmers' own equipment [9].

Managerial functions changing

General observations indicate that neither the importance nor the basic managerial functions of farm operators have been diminished, although most of these functions have greatly changed in nature. Farm operators are still in control of nearly all resources used in farm production and they still control these resources mostly through ownership.

How to organize and use their equities and other resources are the main managerial decisions that a farm operator makes, just as he always did, whether the farm is large or small. In either case, the operator remains the risk-taking manager who commits his work, his managerial skill, and the capital he owns or controls to a production enterprise in order to make a living by selling and/or consuming its output. With respect to his independence as an entrepreneur, it makes no difference whether he negotiates prices for specified products in advance or does so in an open market after they are produced.

While recent structural changes in the farm economy have not changed the farm operator's basic decision-making function, they have greatly changed his other managerial functions. He performs fewer managerial functions in the marketing of farm products and in the implementation of much of the technology used in farm production. Some of his production risks have been shifted by government farm programs and by the increasing involvement in farm production of food processors, feed dealers, and other farm suppliers. Furthermore, more and more managerial services are available to farmers in their farming operations. For example, not long ago the fertilizing of farmland required important managerial decisions by the farmer, drawing greatly on his skill and experience. Today these decisions are less difficult—a telephone call to any well-organized fertilizer dealer can bring competent and valuable help. On the other hand, farmers now have to buy many more inputs and thus require more operating capital. Some management decisions, therefore, have become more complex and more risky, requiring more skill, ingenuity, and knowledge in many new fields.

It appears that the outgoing managerial functions of the farmer are more than offset by incoming ones. His economic importance is definitely increasing, both as seller and as buyer. In 1967 farm production expenses were $33 billion, almost double the $17 billion of 1949; and sales of farm products in 1967 were $41 billion, compared with $27 billion in 1949 (all values expressed in 1957–59 prices). These increasing farm activities are not indicative of any lessening in the importance of farmers' managerial functions.

Concentration of Farm Production

If technology were destroying the family pattern of farm production, as it did in many other commodity producing industries, we would most likely be witnessing a concentration of farm production, farmland, and other productive resources into an increasingly smaller number of large farming organizations. Not so. Farm production, farmland, and other production resources are concentrating—but in a rapidly expanding number of adequate farms of medium and large size (Table 6) [6].

Three additional observations are of special interest with respect to this concentration of farm production. First, farms continue to be mostly family-owned businesses. Income tax return data show that, in 1965, of 3.2 million businesses reporting receipts from farming, 95.9 percent were sole proprietorships; 3.6 percent, partnerships; the remaining 0.5 percent, corporations.

Second, farms continue to be relatively small businesses. While some units may be large in relation to others, and larger than they were before, they are still hardly comparable to the sizes of most other American pro-

Table 6. Number, sales, selected expenditures, and real estate value of farm by specified size and class of farm, United States, 1959 and 1964

Size and class of farm	Number[a]		Sales		Specified expenditures[b]		Value of farm real estate	
	1959	1964	1959	1964	1959	1964	1959	1964
	thousand farms		million dollars					
Large[c]	20	31	4,981	8,539	2,990	5,019	11,136	19,470
Medium[d]	292	371	10,319	13,588	5,321	6,534	31,074	50,273
Small[e]	1,137	972	11,428	10,267	4,963	4,270	49,552	52,672
Part time[f]	2,256	1,782	3,789	2,754	1,953	1,577	31,860	36,617
Total	3,705	3,156	30,517	35,148	15,227	17,400	123,622	159,032
	Percentage distribution							
Large[c]	0.5	1.0	16.3	24.3	19.6	28.8	9.0	12.3
Medium[d]	7.9	11.7	33.8	38.7	35.0	37.6	25.1	31.6
Small[e]	30.7	30.8	37.5	29.2	32.6	24.5	40.1	33.1
Part time[f]	60.9	56.5	12.4	7.8	12.8	9.1	25.8	23.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a] Indian reservations and institutional farms not included.

[b] Includes expenses for feed, livestock, seed, fertilizer, petroleum products, machine hire, and hired labor.

[c] Farms with sales of $100,000 or more.

[d] Farms with sales of $20,000 to $99,999.

[e] Farms with sales of $5,000 to $19,999.

[f] Farms with sales of less than $5,000, whose farm operators' families, as an average, have more nonfarm than farm income.

Source: *1964 Census of Agriculture*, Volume II, Chapter 6.

duction organizations. As a matter of fact, on the basis of present standards used by the Small Business Administration in determining the eligibility of firms for assistance, few farms would be large enough even to qualify as small businesses. Farm production is organized into more and smaller businesses than any other major group of industries or services.

Third, although part-time farming units and small units with less than $20,000 of sales are not very productive, and definitely are not the commercial farms of the future, they are today still an important part of our farm economy. In 1967 2.6 million small farms with less than $20,000 of sales accounted for about 15 billion of farm products sold—32 percent of total sales—and for approximately 7 billion of realized operators' net farm income—48 percent of all farmers' net income.[4] More than 90 percent of our farm population, about 9 million persons, live on these small and part-time farming units. This is a characteristic aspect of our farm economy, and its economic and social significance can hardly be overestimated.

Conclusions

Why then has the techological explosion in farming not destroyed the family and self-employment characteristics in the organization of farm production in most of the United States and its farming enterprises? The biological nature and the spatial dispersion of farm production may be largely responsible, for they make a large concentration of capital, management, and labor more difficult in farming than in other industries. Thus, competitive efficiency (least-cost production) is attained in farming at a smaller firm size than in many other kinds of production, and these smaller sizes in turn are being adapted to the managerial and working capacities of self-employed family labor.

As yet, no technological breakthrough has significantly eliminated the considerable influence of biological and spatial characteristics on the organization of farm production. Farms remain mostly family-operated, family-owned, and relatively small businesses. The coexistence of family and larger-than-family farms, in about the same proportions, continues to characterize the organization of farm production.

However, great changes have been taking place. The present family farms and larger-than-family farms only remotely resemble the family and larger-than-family farms of the past. Farm production is becoming increasingly specialized—concentrating on specific crops and livestock. Farms are becoming more dependent on nonfarm industries for production inputs and for marketing. Some farms have changed so much that we hesitate to call them farms any more. The emphasis on farm ownership is also changing. While farm real estate and farm inventory ownerships remain as strong as ever, the ownership of the farm business itself and many contractual "rights-ownerships" are playing an increasingly more important role in modern farming. For example, a farmer may own rights on the basis of a lease, contract farming arrangement, custom work, or any other operational or financial contract. Many managerial functions are shifting away from farms. Again, many entrepreneurship risks that farmers had to bear only a few decades ago are now lessened by government programs and by contract farming, which tend to insure against extreme commodity price fluctuations and provide market stability. However, farmers face greater risks in their increasing use of capital and credit.

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[4] In 1964 farms with less than $20,000 of sales accounted for 51 percent of all corn produced, 54 percent of all wheat, 79 percent of all tobacco, 50 percent of all milk sold, and 32 percent of all cattle and calves sold.

Changes—radical changes—are the order of the day in agriculture; and their study, in all aspects, should be the main task of our professional endeavors. However, despite all these changes, many characteristics of the organization of the farming industry remain basically unaltered. May I suggest that one of these, the coexistence of family farms and larger-than-family farms in their traditional regional locations, is likely to stay with us for a long time to come.

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A Production-Investment Decision Model of Farm Firm Growth*

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This article presents the conceptualization of a farm firm growth model which includes both investment and production decisions. The results obtained in the application of the model to a hypothetical Central Indiana farm under alternative resource availability and optimizing criteria assumptions are reviewed. These applications demonstrate the interaction between investment and production decisions in the growth process and indicate that under realistic conditions optimal firm growth is not scale growth. They also indicate that the growth process and the terminal size are different for different objective functions. Finally, the results illustrate the applicability of such a model for investigating farm firm adjustments in a growth context.

THE development of micro-economic models which explicitly include the time element has greatly increased our ability to analyze the process of firm growth. Because of rapid growth or changes in size and organization of farm firms, agricultural economists have attempted to develop operational models that explain and predict these phenomena. This article presents the conceptualization and application of a farm firm growth model that includes both investment and production decisions.

Combining Production and Investment Decisions

Three methodologies have been proposed in the literature to combine production and investment decisions in dynamic models to study firm growth: simulation, dynamic programming, and multi-period linear programming.[1] Simulation models developed by Patrick [22] and Harshbarger [10] have been used to evaluate the impact of managerial ability and capital structure on farm firm growth, assuming non-stochastic and stochastic yield and price variations. Harl [9] has used a simulator to evaluate the impact of business organization (sole proprietorship, regular corporation, etc.) on farm firm organization and expansion.

Although dynamic programming has been applied to problems of replacement and feedlot management [14, 23], to our knowledge this methodology has not been applied to the problem of growth of the total farm firm. However, Minden [20] has conceptualized the firm growth problem in a dynamic

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[1] For a more complete review of the application of these methodologies to farm firm growth, see Irwin [12].

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programming framework and has discussed various advantages and disadvantages of this technique.

Examples of the utilization of multi-period linear programming models to study growth problems are much more abundant. Following Dorfman's discussion of the applicability of linear programming to multi-period problems [7], Swanson [24] and Loftsgard and Heady [17] developed the first multi-period planning models. Following in quick succession were applications by Irwin and Baker [13], which concentrated on intra-year financial transfers, and Barr and Plaxico [1], which emphasized capital flows among years. In an aggregate study, Cowling and Baker [4] used multi-period linear programming to estimate regional milk supply of growing dairy farms. Dean and Benedictis [6], Martin [19], Johnson [15], Eidman, Carter, and Dean [8], and Cocks and Carter [3] have more recently made additions to the literature in this area.[2]

Most of the recent work in the application of multi-period linear programming to firm growth has concentrated on the investment decisions, growth rate, and terminal size. For example, Dean and Benedictis, who treat production decisions in more detail than most of the other studies, exogenously determine aggregate annual production activities and make orchard establishment an irreversible decision [6, pp. 299, 302]. Both Martin and Johnson assume a single predetermined aggregate production activity for each time period, and the production activity is the same for all time periods. Thus, the only production decision that must be made each year is the magnitude of the one production activity.

Treating the organization of production as an exogenous and irrevocable decision in a firm growth model seems reasonable if: (1) linear relationships are assumed; (2) one is analyzing the firm in a long-run context where, by definition, all factors of production are variable; (3) all factors, including types of credit, are available in unlimited quantities or, if limited, are available in constant proportions; and (4) relative prices and technology are constant. Under these conditions the firm would be able to generate the largest quantity of investment funds each year by determining the most profitable combination of factors of production and products, acquiring the optimum quantity of the combination of factors, and producing the optimum quantity of the combination of products. Thus, all changes in size of the production unit would be scale changes.[3]

It is important to consider organization decisions or decisions concerning production and annual labor and capital acquisition as an integral part of the growth process when the above conditions are not a reasonable approximation of reality. The existence of resource fixities during specified periods of the planning horizon may cause the optimal production organization to change from period to period as the fixities change. Institutional restrictions may cause the relative availability of particular classes of resources to differ at any point in time and to change over time. For example, credit that can be used to acquire annual inputs may be available in unlimited quantities if its proposed use can be shown to be profitable, while credit that will be used to purchase durable inputs may be limited to a specified proportion of the firm's net worth.[4] Thus, the availability of durable inputs may be more restricted than the availability of annual inputs during any particular period, and the relative availabilities of these inputs may change as net worth increases. Similarly, the farmer's ability and willingness to manage hired labor may place a limit on the labor supply the firm will utilize. This limited labor utilization combined with an increasing supply of capital may allow substitution of capital for labor, resulting in changes in the optimum organization of the firm over time.

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[2] Applications of recursive linear programming to the firm growth problem have been made by Day [5] and Heidhues [11].

[3] Even if the above conditions do not hold, external factors such as government programs or climatic and soil conditions may make exogenous production decisions realistic if they limit the firm to the production of one product with only one type of technology. See Martin [19].

In the following discussion, the conceptualization of the growth process is presented verbally, in equation form, and in matrix form. The growth model is then applied to a corn-hog farm typical of Central Indiana and comparisons are made between the growth processes that occur under different assumptions of labor availability. Finally, the expansion processes resulting from two different objective functions are analyzed. The discussion emphasizes the process of growth (the optimal combination of enterprises, techniques of production, and investments over time) under different resource assumptions and objective functions rather than concentrating on the terminal values of the growth variables.

The Growth Process

As conceptualized in this study, growth is made possible through the generation of investable funds.[5] Two sources of investable funds are available to the firm in any time period. First, disposable income in excess of consumption requirements increases the availability of funds in the following period.[6] Second, the firm may borrow funds. The borrowing capacity (total debt load) of the firm during any period is a function of net worth at the end of the previous period. Permissible *new* borrowing in any period is the difference between borrowing capacity and outstanding debt. The firm's borrowing is also constrained by the ability to service debt out of future income.

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[4] Irwin and Baker [13] and Neuman [21] indicate that lending institutions tend to place less emphasis on collateral for short-term loans than for longer-term loans.

[5] Growth may be defined as an increase in the size of the firm. In this study, growth is measured by change in net worth and disposable income.

[6] Disposable income is defined as net revenue above variable costs less debt servicing (principal plus interest).

The generation of investable funds from both internal and external sources increases the ability of the firm to acquire additional durable inputs (land, machinery, buildings and facilities). The productive capacity of the firm is increased by the acquisition of these additional durable inputs, and this increased productive capacity can be used to produce a larger quantity of output. Finally, a higher level of output will result in a higher level of disposable income and/or increased net worth depending upon the objective of the firm.

Production and investment decisions are interdependent over time in the growth process. Thus, current optimal production and investment decisions are dependent upon past production and investment decisions, as well as future production and investment opportunities.

The Conceptualized Farm Firm Growth Model

The above conceptualization of the growth process now is presented in equation form. The notation used in the following equations deviates from standard linear programming notation in that only the production activities are denoted by the symbol X_{jt}, the jt subscripts indicating a specific activity and a time period, respectively. To emphasize their difference from the production activities, other specialized activities are denoted by capital English letters (for example, I_{jt} denotes investment activities, S_{jt} denotes sale activities, etc.). Constraints are also identified by capital English letters, but with ik subscripts rather than jt. Ranges on the activities and constraints are denoted by small English letters. All coefficients are identified with Greek letters.

Two time subscripts are incorporated in the model, one for the period of the decision and one for the period of accounting. The decision period is denoted by the subscript t and is usually carried on all activities. The accounting period is denoted by the subscript k and is usually carried on all constraints. When the accounting period and the decision period are the same, it is indicated in the equation by the subscript $k=t$.

The following equations specify the firm growth process:
Maximize: Discounted Disposable Income

$$(1)\quad \underset{\substack{\text{(present}\\ \text{value dis-}\\ \text{posable}\\ \text{income}\\ \text{stream)}}}{DI'} = \sum_{t=1}^{T} \underset{\substack{\text{(sum of discounted annual dis-}\\ \text{posable income)}}}{\frac{\sum_{j=a}^{d} \eta_{jt} X_{jt} + \sum_{j=v}^{x} \eta_{jt} Y_{jt} - \sum_{j=e}^{g} D_{jt}}{(1+\rho)^{t}}}$$

or

Maximize: Net Worth (with $k = T$)

$$(2) \quad \underset{\text{(Net worth)}}{NW_k} = \underset{\substack{\text{(adjusted}\\ \text{initial}\\ \text{net worth)}}}{\overline{NW}_k} + \underset{\substack{\text{(total farm}\\ \text{investment)}}}{\sum_{j=h}^{l}\sum_{t=1}^{k} \tau_j I_{jt}} - \underset{\text{(total depreciation)}}{\sum_{j=h}^{l}\sum_{t=1}^{k} \beta_{jt}\delta_j\tau_j I_{jt}}$$

$$- \underset{\text{(total sales)}}{\sum_{j=m}^{q}\sum_{t=1}^{k} \tau_j S_{jt}} + \underset{\substack{\text{(adjustment of}\\ \text{depreciation}\\ \text{for sales)}}}{\sum_{j=m}^{q}\sum_{t=1}^{k} \theta_{jt}\delta_j\tau_j S_{jt}} + \underset{\substack{\text{(income transfer}\\ \text{from } k \text{ to } k+1\text{)}}}{\sum_{j=r}^{u} T_{jt=k}}$$

$$+ \underset{\substack{\text{(off-farm}\\ \text{investment)}}}{\sum_{j=v}^{x} Y_{jt=k}} - \underset{\substack{\text{(total bor-}\\ \text{rowing)}}}{\sum_{j=y}^{z}\sum_{t=1}^{k} N_{jt}} + \underset{\substack{\text{(principal repay-}\\ \text{ment)}}}{\sum_{j=y}^{z}\sum_{t=1}^{k} \beta_{jt}\gamma_j N_{jt}}$$

subject to: Production Capacity

$$(3) \quad \underset{\substack{\text{(resource}\\ \text{utilization)}}}{\sum_{j=a}^{d} \alpha_{ijt} X_{jt}} \leq \underset{\substack{\text{(resource}\\ \text{availability)}}}{B_{ik=t}}$$

where: Physical Resource Availability (i = j)

$$(4) \quad \underset{\substack{\text{(resource}\\ \text{avail-}\\ \text{ability)}}}{B_{ik}} = \underset{\substack{\text{(adjusted}\\ \text{initial}\\ \text{resource}\\ \text{endowment)}}}{\overline{B}_{ik}} + \underset{\substack{\text{(total non-}\\ \text{obsolete}\\ \text{farm invest-}\\ \text{ment)}}}{\sum_{t=1}^{k} \sigma_{jt} I_{jt}} - \underset{\text{(total sales)}}{\sum_{t=1}^{k} \sigma_{jt} S_{jt}}$$

subject to: Investment Capacity

$$(5) \quad \underset{\text{(farm investment)}}{\sum_{j=h}^{l} \xi_{ijt} I_{jt}} + \underset{\text{(off-farm investment)}}{\sum_{j=v}^{x} \xi_{ijt} Y_{jt}} \leq \underset{\substack{\text{(available liquid}\\ \text{capital)}}}{M_{ik=t}}$$

where: Liquid Capital Availability ($i = j$)

$$\underset{\text{(available liquid capital)}}{M_{ik=t}} = \underset{\text{(cash available in period 1)}}{\overline{M}_{i1}} + \underset{\text{(new borrowing)}}{N_{jt}} + \underset{\text{(income transfer from previous period)}}{T_{jt-1}} + \underset{\text{(off-farm investment)}}{Y_{jt-1}} + \underset{\text{(sales)}}{\tau_j S_{jt}} \tag{6}$$

subject to: Borrowing Capacity

$$\underset{\text{(new borrowing)}}{\sum_{j=y}^{z} N_{jt=k}} \leq \underset{\text{(total borrowing capacity)}}{\lambda NW_{k-1}} - \underset{\text{(borrowing through previous period)}}{\sum_{j=y}^{z}\sum_{t=1}^{k-1} N_{jt}} + \underset{\text{(principal repaid through previous period)}}{\sum_{j=y}^{z}\sum_{t=1}^{k-1} \sigma_{jt}\gamma_j N_{jt}} \tag{7}$$

subject to: Debt Service Requirement $(i=j)$

$$\underset{\text{(principal and interest paid)}}{\sum_{j=e}^{g} D_{jt=k}} = \underset{\text{(principal and interest due)}}{\sum_{i=a}^{d} Z_{ik}} \tag{8}$$

where: Debt Servicing Schedule $(i=j)$

$$\underset{\text{(principal and interest due)}}{\sum_{i=a}^{d} Z_{ik}} = \underset{\text{(payment on initial debt)}}{\overline{Z}_{ik}} + \underset{\text{(principal payments)}}{\sum_{j=y}^{z}\sum_{t=1}^{k} \sigma_{jt}\gamma_j N_{jt}} \tag{9}$$

$$+ \underset{\text{(Interest payments)}}{\sum_{j=y}^{z} \rho_j^{*} \left[\sum_{t=1}^{k} \sigma_{jt}(N_{jt} - \beta_{jt}\gamma_j N_{jt}) \right]}$$

subject to: Income Transfer

$$\underset{\text{(income transfer to next period)}}{\sum_{j=r}^{u} T_{jt=k}} \leq \underset{\text{(annual disposagle income)}}{DI_k} - \underset{\text{(consumption)}}{[F + \psi(DI_k - F)]} \tag{10}$$

where: Annual Disposable Income

$$(11) \quad \underset{\text{(annual disposable income)}}{DI_{k=t}} = \underset{\text{(farm income above variable costs)}}{\sum_{j=a}^{d} \eta_{jt} X_{jt}} + \underset{\text{(off-farm income)}}{\sum_{j=v}^{x} \eta_{jt} Y_{jt}} - \underset{\text{(principal and interest payments)}}{\sum_{j=e}^{g} D_{jt}}$$

subject to: Non-Negativity Condition

$$(12) \qquad X_{jt}, D_{jt}, I_{jt}, N_{jt}, T_{jt}, S_{jt} \quad \text{and} \quad Y_{jt} \geqq 0$$

Subscripts:[7]

j = the activity, $j = a \ldots z$;
i = the input constraint, $i = a \ldots z$;
t = the period of the decision, $t = 1 \ldots T$;
k = the period of accounting, $k = 1 \ldots T$.

Coefficients:

η_{jt} = the annual return above variable cost of one unit of activity j in period t;
ρ = the interest rate used for discounting disposable income;
τ_j = the investment or sale *price* of asset j;
β_{jt} = for assets, the years owned or the depreciable life, whichever is less, of the jth asset purchased in period t; for loans, the years the loan has been serviced or the loan maturity, whichever is less, of the jth type of debt incurred in period t;
δ_j = rate of annual depreciation for asset j;
θ_{jt} = years of depreciable life of asset j between year of sale (t) and year of accounting (k);
γ_j = principal repayment rate on borrowing of type j;
α_{ijt} = the amount of resource or capacity of type i necessary to satisfy one unit of the production activity of type j in period t;
σ_{jt} = for asset j purchased in period t, equal to zero if obsolete or one if not obsolete; for borrowing of type j in period t, equal to zero if mature, or one if not mature;
ξ_{ijt} = the quantity of liquid capital of type i necessary to purchase one unit of asset or off-farm investment j in period t, $(\Sigma_{i=e}^{h} \xi_{ijt} = \tau_j)$;
λ = proportion of net worth that can be borrowed;
ρ_j^* = the rate of interest on debt of type j;
ψ = the marginal propensity to consume.

Decision variables:

X_{jt} = the level of production or annual input acquisition activity j in period t;

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[7] Definitions of subscripts, coefficients, and variables are listed in the order of appearance of the terms in the model.

D_{jt} = the dollar amount of debt servicing of type j in period t;
I_{jt} = the level of investment in durable asset j in period t (physical units);
S_{jt} = the level of sale of durable asset j in period t (physical units);
T_{jt} = the level of annual income transfer of type j from period t to period $t+1$;
Y_{jt} = the level of off-farm investment of type j in period t;
N_{jt} = the level of borrowing of type j in period t.

State variables:

DI' = the present value of the stream of disposable income;
NW_k = the net worth of the firm at the end of period k;
$\overline{NW}_k$ = the net worth at the beginning of period one minus initial cash balance and depreciation to year k (exogenously determined);
B_{ik} = the physical amount of resource i available in period k;
$\overline{B}_{ik}$ = the amount of the initial endowment of resource i adjusted for obsolescence to period k (exogenously determined);
M_{ik} = the amount of liquid capital of type i available in period k;
$\overline{M}_{i1}$ = the amount of initial endowment of liquid capital of type i (exogenously determined and available in the first period ($k=1$) only);
Z_{ik} = the amount of principal and interest on debt of type i due in period k;
$\overline{Z}_{ik}$ = the amount of principal and interest on initial outstanding debt of type i that must be serviced in period k (exogenously determined);
DI_k = the amount of annual disposable income generated in period k;
F = the minimum consumption level ($3,000).

Two alternative objective functions are incorporated in the model. The first objective function maximizes the present value of the annual disposable income stream. Present value of disposable income, equation (1), is the sum of the discounted annual disposable incomes over the planning horizon.[8] Annual disposable income, equation (11), is defined as annual net revenue above variable costs from farm production and off-farm investments less annual debt servicing (principal plus interest). Thus, it is the quantity of funds available for consumption, payment of income taxes, reinvestment in the firm, and investment outside the firm.

The second objective function, equation (2), assumes the maximization of the net worth of the firm at the end of the planning horizon. Net worth in period $k=T$ is defined as the net worth at the beginning of period one, adjusted for initial cash balance and depreciation to year T, plus the total new investment in durable assets to year T, minus the total accumulated depreciation of these assets,[9] minus sale of assets through period T,[10] plus adjustment for depreciation on assets sold through period T,[11] plus the amount of cash transferred to the next period, plus the value of the off-farm investments in period T, minus the net borrowing to year T (total borrowing minus repayment of principal).[12]

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[8] A time preference and risk discount factor of $1/(1+.10)^t$ was assumed.

[9] Because the investment term in this equation $(\Sigma\Sigma_{jt}r_jI_{jt})$ accumulates new investment, the

The technical and institutional constraints on the objective functions are summarized in equations (3), (5), (7), (8), and (10). Production capacity is constrained in any period by the quantity of resources available, as indicated by equation (3). The quantity of resources available, equation (4), is defined as the endowment at the beginning of period one, adjusted for obsolescence, plus accumulated new investments adjusted for obsolescence (if a specific I_{jt} is obsolete, its $\sigma_{jt}=0$), minus sales of durable assets. The dollar amount of durable assets and off-farm investments that can be acquired in any period is limited by the amount of liquid capital available in the period, equation (5). Available liquid capital in any period is defined by equation (6) as the sum of borrowing in that period, the liquid capital transferred from the previous period, liquid capital invested outside the firm in the previous period, and capital obtained from the sales of durable assets.

Permissible new borrowing in any period is total borrowing capacity minus outstanding debt, with total borrowing capacity being a function of net worth, equation (7). The debt servicing requirement is identified by equation (8), with the debt servicing schedule, equation (9), defined as principal and interest payments on the outstanding debt at the beginning of period one plus principal payments on incurred debt that hasn't matured (if a specific N_{jt} has matured, $\sigma_{jt}=0$) and interest on the unpaid balance of debt incurred through the present year. Finally, the amount of funds that can be transferred to the following period is defined by equation (10) as the annual disposable income minus annual consumption.[13]

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depreciation term ($\Sigma\Sigma_{jt}\beta_{jt}\delta_j\tau_j I_{jt}$) must reduce this gross investment figure to net investment. The β_{jt} coefficient equals either the years the asset has been in service or the useful life of the asset if its serviceable life is over. Thus, if a depreciable asset has completely deteriorated, the total depreciation of this asset equals the purchase price.

[10] Because receipts from sale of assets add to liquid capital that can be reinvested, the value of sales must be deducted to avoid double counting.

[11] Since the depreciation term in this equation ($\Sigma\Sigma_{jt}\beta_{jt}\delta_j\tau_j I_{jt}$) accumulates depreciation on all assets from the year of purchase to year k or until the item is fully depreciated, it is necessary to adjust accumulated depreciation for assets sold through period k. This is the function of the term ($\Sigma\Sigma_{jt}\theta_{jt}\delta_j\tau_j S_{jt}$) where θ_{jt} is the number of years of depreciable life between the year of sale (t) and the year of accounting (k).

[12] The β_{jt} coefficient plays the same role in the principal repayment term ($\Sigma\Sigma_{jt}\beta_{jt}\gamma_j N_{jt}$) as it did in the depreciation term. It equals either the years since the loan was made or the maturity if the loan has been repaid.

[13] A minimum annual consumption of \$3,000 was specified. In addition to the minimum consumption level, a marginal propensity to consume 50% of all disposable income above \$3,000 was assumed. This consumption function is postulated to meet family requirements plus income taxes.

The Model in Matrix Form

Table 1 illustrates a two-period growth model in linear programming matrix form. The decision variables included in each subset of activities have been defined. The numbers in parentheses after the constraints refer to analogous equations in the conceptual model. The A_{ijt}'s ($t=1, 2$) indicate submatrices of coefficients relating the activities and the constraints.

The C_{jt}'s ($t=1, 2$) in the objective function accumulate the value of the variable being maximized. When discounted disposable income is maximized, C_{jt} coefficients ($t=1,2$) in the division of income activities accumulate the entire amount of discounted annual disposable income in the objective function. If the C_{jt}'s in the division of income activities in Table 1 are eliminated and replaced by a $C_{jt}=1$ in the net worth activity for the last period in the planning horizon, the objective function is transformed from maximizing present value of disposable income to maximizing terminal net worth.

It should be noted that the annual disposable income equation is included in the model as an accounting equation when net worth is maximized, equation (2), and annual net worth is included as an accounting equation when discounted disposable income is maximized, equation (1). Thus, total farm size and growth can be measured in terms of either disposable income or net worth regardless of the objective.

Application of the Model

The multi-period linear programming model was applied to a hypothetical farm firm assuming a ten-period planning horizon.[14] Each period comprises one calendar year. Technical coefficients and input and product prices were assumed to be constant throughout the 10 years. Since the objectives of the study were to analyze the impact of resource availability and different optimizing criteria on farm firm growth, incorporating technical coefficients and prices as variables would not allow one to isolate the relationship between resource changes, optimizing criteria and growth. The technical coefficients and prices were assumed to be those that exist for high level managers at the present time and were acquired from various farm management research and extension publications.

The initial resource endowment assumed and the production alternatives considered are typical of a small corn-hog farm of Central Indiana. The endowment consisted of 160 acres of cropland, sufficient machinery and equipment to produce row crops on the land, facilities to accommodate the

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[14] A simultaneous solution multi-period model, as used in this study, results in a global optimum by solving for all periods in the planning horizon simultaneously. Conversely, a recursive multi-period model is solved for each period independently of all future periods (with the output from the period t being used as input for the period $t+1$). Thus, the recursive model does not allow for the allocation of resources among periods, and suboptimization may result.

Table 1. The multi-period linear programming matrix

	Period 1				Period 2					
	Production and annual input acquisition activities (X_{j1}, Y_{j1})	Investment activities (I_{j1}, S_{j1})	Credit activities (borrowing and debt servicing) (N_{j1}, D_{j1})	Division of income activities (T_{j1})	Production and annual input acquisition activities (X_{j2}, Y_{j2})	Investment activities (I_{j2}, S_{j2})	Credit activities (borrowing and debt servicing (N_{j2}, D_{j2})	Division of income activities (T_{j2})	Net worth	Right-hand-sides
Objective function (1) and (2)				C_{j1}				C_{j2}		
Period 1										
Liquid capital constraints (5, 6)		A_{ij1}	A_{ij1}							$\leq b_i$
Annual input constraints (3, 4)	A_{ij1}									$\leq b_i$
Durable input constraints (3, 4)	A_{ij1}	A_{ij1}								$\leq b_i$
Credit constraints (7, 8, 9)			A_{ij1}							$\leq b_i$
Annual disposable income (11)	A_{ij1}		A_{ij1}	A_{ij1}						$= b_i$
Annual net worth (2)		A_{ij1}	A_{ij1}	A_{ij1}						$\leq b_i$
Period 2										
Liquid capital constraints (5, 6)				A_{ij2}		A_{ij2}	A_{ij2}			$\leq b_i$
Annual input constraints (3, 4)					A_{ij2}					$\leq b_i$
Durable input constraints (3, 4)		A_{ij2}			A_{ij2}	A_{ij2}				$\leq b_i$
Credit constraints (7, 8, 9)		A_{ij2}	A_{ij2}				A_{ij2}			$\leq b_i$
Annual disposable income (11)					A_{ij2}		A_{ij2}	A_{ij2}		$= b_i$
Annual net worth (2)		A_{ij2}	A_{ij2}			A_{ij2}	A_{ij2}	A_{ij2}	A_{ij2}	$\leq b_i$

labor intensive production of 40 two-litter sows per year, one man-equivalent of operator labor, and the opportunity to hire an additional man-equivalent of labor. The owner-operator was assumed to possess a 40 percent equity in the assets of the firm.[15]

Alternative production activities incorporated in the model include both labor and capital intensive corn and hog enterprises as well as soybeans, wheat, dairy and beef-feeder enterprises. In addition, the matrix for each year contained investment, credit, debt servicing, land renting (in and out), external investment, and income transfer activities. In all, 79 activities and 44 constraints were specified for each year, resulting in a triangular matrix for the 10-year planning horizon with 790 columns and 440 rows.

Analysis of the Growth Process

The growth process resulting from the application of the growth model to the hypothetical farm firm is summarized in Table 2, which indicates

Table 2. Summary of the growth process of the farm firm assuming one man-equivalent of hired labor and disposable income maximization

Year	Corn[a]	Corn[b]	Hogs[c]	Hogs[d]	Hogs[e]	Hogs[f]	New borrowing	Disposable income[g]	Net worth
	acres		sows[h]			pigs	intermediate-term[i]	dollars	
1	160		48				2,503	8,630	65,628
2	160		71				3,835	11,811	77,181
3	151	13	111				7,466	19,896	91,627
4		101	144				6,804	21,576	108,338
5		103	132	7	9	219		24,596	127,512
6		114	120	15	16			26,382	142,466
7		125	120		34	469		31,150	159,353
8		125	120		34	1,311		36,004	176,812
9		125	120		34	1,985		38,506	185,904
10		127	107	13	37	2,833		42,280	195,747

[a] conventional tillage
[b] minimum tillage
[c] labor-intensive technique, farrow and finish on pasture
[d] mixed technique, farrow in confinement and finish on pasture
[e] capital-intensive technique, farrow and finish in confinement
[f] labor-intensive, purchase and finish feeder pigs on pasture
[g] These quantities are *not* discounted. The quantity of internally generated capital available to invest in the following period can be calculated by the following formula:
Internal capital available for time period $k = .5$ (Disposable Income $_{k-1}$ —$3,000).
[h] 18 pigs/year/sow
[i] dollars

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[15] The beginning asset-liability structure was determined by valuing long-term assets (land) and intermediate-term assets (machinery, buildings, and facilities) at purchase price minus depreciation and then giving the owner a 40 percent equity and 60 percent liability in each class of assets.

the annual enterprise organization, borrowing, disposable income, and net worth for each of the ten periods when discounted disposable income is maximized.

Hog and corn production enterprises dominate the firm organization during the entire planning horizon. However, changes in relative size as well as production technique occur in these enterprises. These are explained by changes in the relative availability of resources resulting from the assumed restrictions on labor hiring, the internal generation of capital and the deterioration of initial endowments of machinery and livestock facilities.

The size of the corn enterprise remains relatively constant during the first three years of the planning horizon. By the fourth period, the initial endowment of conventional tillage machinery has completely deteriorated and the upper limit on labor acquisition has been attained. As a result, minimum tillage equipment is purchased (thus substituting capital for labor in corn production) to produce 101 acres of corn, and the remaining owned land is rented out. This capital-intensive production technique continues to dominate the corn enterprise for the remainder of the planning horizon, but continued competition from the hog enterprise for both labor and capital restricts growth of this enterprise.

The hog enterprise expands rapidly throughout the planning horizon. Investment is made in labor-intensive production facilities for the first four periods until labor becomes limiting, and then a transition begins from labor-intensive to capital-intensive farrowing-finishing of hogs. However, investment in labor-intensive finishing facilities continues during the remainder of the planning horizon to provide capacity for the finishing of feeder pigs, an operation that utilizes free labor during the first four months of the year.

The expansion of the hog enterprise during the early years requires utilization of capital in addition to that generated internally, and all available intermediate-term credit is acquired during the first three periods. By period five the marginal value product of a unit of external capital is lower than the marginal factor cost and thereafter only internally generated funds are used for new investment. No long-term debt is incurred during the entire planning horizon.

As indicated in Table 2, both the disposable income and net worth of the firm increase throughout the planning horizon. By the tenth year, the net worth of the firm has almost tripled and annual disposable income of $42,280 is generated.

Impact of Labor Availability

The growth processes resulting from two different levels of labor availability were compared to examine the impact of this resource on farm firm growth. Both levels assumed one man-equivalent of operator labor to be available in all years. In addition, labor could be hired, when profitable to do so; but only one man-equivalent could be acquired under assumption I whereas three man-equivalents of labor could be hired under assumption II. The initial availability of all other resources was assumed to be identical.

The firm organizations generated under both labor assumptions are identical during the first three years. However, beginning in year four, the upper limit on labor hiring is attained under assumption I and differences in labor availability result in different growth paths. The ability to acquire more labor results in the utilization of more credit and thus facilitates the more rapid expansion of the productive capacity in both the hog and corn enterprises. The transition from labor-intensive to capital-intensive hog production occurs later in the planning horizon when three man-equivalents of hired labor are available. In fact, the production of hogs in capital-intensive facilities remains quite insignificant throughout the planning horizon under the less restrictive labor assumption.

The availability of labor also influences the timing of external capital utilization. Intermediate-term capital is borrowed during more periods when more labor is available; but under both labor assumptions, new capital borrowing is discontinued during or immediately following the period when the upper limit on labor acquisition is attained.

Higher levels of annual disposable income are generated when labor availability is less restricted. The generation of more disposable income results in a larger amount of liquid capital that can be invested in the following year and, thus, higher levels of investment, capital stock, and net worth during successive years.

Comparison of Two Optimizing Criteria

A comparison between two potential optimizing criteria or goals of the farm manager was obtained by incorporating in the model two different objective functions having identical initial resource endowments. These functions were (1) maximization of the discounted stream of disposable income over the planning horizon and (2) maximization of net worth at the end of the planning horizon. Results obtained under the first objective function were presented earlier in Table 2. The results obtained when net worth is maximized will now be contrasted with the earlier results.

After the third year, substantial differences occur in the enterprises included in the firm organization under the two criteria.[16] The corn enterprise is eliminated from the organization and the owned land is rented out during the fourth year when net worth is maximized, because machinery is not replaced as it deteriorates. After year six, the production of hogs in capital-intensive facilities expands much more rapidly under the net worth criterion. However, much of this production occurs in mixed production facilities where either the farrowing or the finishing occurs in capital-intensive facilities and the other operation occurs in labor-intensive facilities.

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[16] These results are in contrast with those presented by Martin [19] where different objective functions result in the same firm organization and firm size. One explanation for the differing conclusions is that our study incorporates a more complete specification of investment and production alternatives, allowing for factor substitution, whereas Martin's study does not allow factor substitution. In addition, the disposable income objective function used in this study does not correspond to any of Martin's objective functions.

Differences in the investment and credit components of the firm organization provide the most interesting comparisons between the two objective functions. No long-term credit is employed in any year and new intermediate-term credit is acquired only through the fourth year when the disposable income criterion is used. In contrast, all available long-term and intermediate-term credit is utilized during the entire planning horizon when the net worth criterion is used. Under this criterion, borrowing in period 10 is limited not only by the firm's net worth but also by the ability to service debt, since disposable income is reduced to the minimum consumption level.

The two maximization criteria result in different investment strategies relative to the durability of assets purchased. When the disposable income criterion is used, all the assets purchased are depreciable assets, such as buildings and machinery. Under the net worth criterion, the major asset purchased is land. By the tenth year, 385 acres of land have been acquired and added to the 160 acres included in the initial endowment. None of this land is tilled by the operator. Instead, it is all rented out because the return to labor and intermediate-term capital in hog production is greater than in crop production.[17]

The annual disposable income generated under the net worth optimizing criterion remains consistently below that generated under the disposable income criterion, indicating the much larger debt servicing payments that must be made when more credit is utilized. However, substantially more net worth is generated when the net worth criterion is used. Thus, differences in the rate of growth may be explained by different objective functions as well as by the use of different variables to measure growth.

Implications for Firm Growth

The empirical results indicate that in all cases the farm becomes more concentrated in the production of hogs, the most profitable enterprise, as it expands over the ten-year period. These results are consistent with the current trend in midwestern agriculture toward specialization and indicate that this specialization is a logical attempt by farm managers to expand their operations as rapidly as possible.[18]

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[17] For a more complete explanation of this phenomenon, see Boehlje [2, pp. 149–151]. pp. 149–151].

[18] Some would argue that specialization in crops is more typical than specialization in livestock in the Midwest. Obviously, the prices and technical coefficients assumed will influence the area of specialization.

The growth process also consistently included the substitution of capital for labor as the availability of labor became more restricted and capital availability increased. Not only is this capital-labor substitution consistent with current trends, but it also indicates that institutional and behavioral restrictions on the availability of resources *may be* as influential as relative price changes in causing resource substitutions.

During the early periods of the planning horizon, high shadow prices exist on the credit restrictions and the capital resource. These high shadow prices indicate that institutional credit restrictions based on collateral rather than the expected profitability of the investment limit the early expansion of the firm.

The substitution of capital for labor and the enterprise changes also illustrate the necessity to consider investment and production decisions interdependently. Thus, it is important for the agricultural producer to increase his planning horizon beyond the current production period if he expects to make optimal investment and production decisions.

The comparison of the two optimizing criteria indicates the impact of alternative growth strategies. When net worth is maximized, a heavy debt load is incurred and the amount of disposable income available to satisfy farm family consumption is restricted. In contrast, the objective of maximizing disposable income results in the generation of substantially less net worth, but much less credit is used and more income is available for consumption. Consequently, under the assumptions of this study, it can be concluded that the objective of maximizing net worth will generate a greater value of owned assets, but farm family consumption must be sacrificed and a more vulnerable debt position is acquired.

Implications for Further Research

The inclusion of both capital-intensive and labor-intensive production activities and related investment activities enables this model to consider capital-labor substitution in a production-investment framework. This flexibility allows the model to generate realistic results as relative resource availability changes over time. Price changes, price trends, and trends in technical coefficients were not incorporated in the model; but they could easily be included and would provide valuable information on the impact of price variability on the growth process.

As indicated by Walker [25], one of the major limitations of the multiperiod linear programming formulation of the growth process is the difficulty of incorporating elements of risk and uncertainty in the model. Consequently, outcome of future periods is known with certainty when the organization of earlier periods is determined. Walker suggests that solving a simultaneous multi-period model in a recursive manner with updated coefficients might be one method of skirting the problem of risk incorporation and might be a more realistic approach to the decision-making process [25, p. 1527]. Alternatively, Johnson, Tefertiller, and Moore [16] have incorporated a distribution of crop yields in a deterministic linear programming model to demonstrate the impact of random variations in yield on firm growth. Additional research is needed to find a realistic and feasible way of treating risk and uncertainty in firm growth models of the type presented in this paper.

Although income taxes were considered in the model, the procedure used was quite naive. Income, property, and real estate taxes are important variables in formulating growth strategies and a further extension of this model could incorporate these variables as decision variables.

Finally, the results of this study raise the issue of whether profit maximization is the long-run goal of managers. According to Lutz and Lutz [18], net worth maximization is consistent with profit maximization. The maximization of discounted disposable income is analogous to the cash flow arguments of the business school. Interestingly enough, the disposable income criterion generates more realistic results than the net worth criterion. Further behavioral research may indicate that this is characteristic only of this particular model, or that the arguments and concepts of the business school more accurately describe farmer behavior than do those of the economic theoretician.

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Sources of Agricultural Productivity Gap Among Selected Countries*

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This study explores the causes of enormous agricultural productivity differences now existing among the developed and less developed countries. Factors are identified that determine the productivity gap, and their influences are gauged on the 1957–62 national aggregate data of 38 nations. Aggregate production functions are estimated on the cross-country data; and, with the estimates of production elasticities, the productivity differences between India and United States and between India and Japan are accounted for by conventional inputs (labor, land, fertilizer and machinery) and nonconventional inputs (education and research). The measured contributions of respective factors to the productivity differences provide a guideline for allocating development efforts in the less developed countries.

THIS essay aims to identify factors that determine differences in agricultural productivity of the developed and the less developed countries and to gauge the influence of these factors. Since Colin Clark [1] pioneered the work, those who have made international comparisons of agricultural production have been struck by the enormous gap in agricultural productivity existing in the world.[1] The gap is indeed great. Recent estimates by the author indicate that the gross farm output (net of seed and feed) per male worker of India is only 2.3 percent of that of the United States and 20.7 percent of Japan's for 1957-62 [6]. The exploration of this gap in agricultural productivity should now have priority, considering the fact that agriculture lagging at the low level of productivity constitutes a serious impediment to the industrialization and economic growth of developing nations today.

In this study, we shall identify factors that determine the farm output of nations by estimating the aggregate production function of world agriculture on the basis of cross-country data. With the estimates of production elasticities, we shall try to explain the differences in labor productivity in agriculture between the United States and India, and between Japan and India, by the factors identified.

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Approach and Data

The basic approach used in this study consists of (1) estimating the aggregate agricultural production function of the unrestricted Cobb-Douglas form, using four separate variables for land, labor, fertilizer, and machinery, and introducing, in addition, variables for education and RDE (research, development and extension), on the basis of cross-country data of 38 nations,[2] and (2) accounting for the percentage differences in output per male worker between the United States and India, and between Japan and India, by the percentage differences in the conventional inputs per worker and in the levels of education and RDE (research, development, and extension) with the estimated production elasticities. Two categories of man-made factors, one a substitute for land and another for labor (A. K. Sen's landesque capital and laboresque capital [15]) are represented respectively by fertilizer and machinery. In principle, our approach is similar to the one adopted by Griliches to account for the "measured productivity growth" of U.S. agriculture with the production function estimated on the U.S. cross-regional data [4, 5].

Data were taken from the recent compilation of international agricultural production statistics prepared by the author, with associates, at the Institute of Asian Economic Affairs [6]. All variables for the estimation of production function are expressed as the aggregates of nations. In principle, flow variables are averaged for 1957-62 and stock variables are measured in 1960. Needless to say, availability and international comparability of data largely determined the specification of variables.

The output variable is the composite cross-country series of gross agricultural output, which is the geometric mean of three cross-country series of gross output net of seeds and feed. Each series corresponds to a set of farm-gate prices (or import prices) of the United States or Japan or India, used for aggregation. Output series with the set of prices of a nation are subject to the kind of bias characteristic of the Laspyres quantity index. By taking the geometric mean of three such series, we expected to cancel out the biases due to the special price structures of the respective nations.[3] Quantity data are mainly taken from FAO [17, 18, 19]. Due to

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[1] The studies that followed Clark's pioneering work are surveyed in [2]. A more recent study is by FAO [20, pp. 95–134.]

[2] Nations included in the sample for the estimation of production function are Argentina, Austria, Australia, Belgium (including Luxemburg), Brazil, Canada, Ceylon, Chile, Taiwan Colombia, Denmark, Finland, France, Germany (Federal Republic), Greece, India, Ireland, Israel, Italy, Japan, Mauritius, Mexico, Netherlands, New Zealand, Norway, Peru, Philippines, South Africa, Spain, Surinam, Sweden, Switzerland, Syria, Turkey, United Arab Republic, United Kingdom, United States, and Venezuela. Major limitation for the size of sample is the availability of data, especially for seeds and feed [17].

[3] If we denote quantity produced of the jth commodity in the ith country by q_{ij}, corresponding quantity of seed and/or feed to be deducted by d_{ij} and the wheat relative prices of the

data limitations, capital formation and stock changes are not counted in the output, which may cause the underestimation of output for countries where livestock production or production based on perennial plants is expanding rapidly. Price data for the weights of aggregation are taken from various government publications.[4]

As the labor variable, we took the number of male workers in the economically active population in agricultural occupations (agriculture, fishery, forestry and hunting) of ILO [24], deducting the number of fishery and forestry workers. The deduction was made by multiplying the labor population in agricultural occupations with the ratios of the output of agriculture to the output of agriculture, forestry and fishery combined. The ratios were calculated on the set of Japanese price weights,[5] a convention adopted because of the data limitation. Their use must be causing bias to our labor series, but it is difficult to ascertain the direction of the possible bias. Only male workers are counted, in order to preserve international comparability. This may tend to underestimate labor for Asian countries.

The land variable is the area of agricultural land in hectares, including permanent meadows and pastures, as reported by FAO [19]. This specifi-

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United States, Japan, and India, by $W(U)_j$, $W(J)_j$, and $W(I)_j$, respectively, our composite series of gross output, Y_i's, are expressed as

$$Y_i = \sqrt[3]{Y(U)_i \cdot Y(J)_i \cdot Y(I)_i}$$

where

$$Y(U)_i = \sum_j W(U)_j \cdot (q_{ij} - d_{ij}), \qquad Y(J)_i = \sum_j W(J)_i \cdot (q_{ij} - d_{ij})$$

and

$$Y(I)_i = \sum_j W(U)_j \cdot (q_{ij} - d_{ij}).$$

The underlying assumptions of the above aggregation procedures are: (1) there exist three types of relative price structures characteristic of the three stages of economic development, which may be called "Advanced Stage," "Mid-way Stage," and "Initial Stage;" (2) those three stages are represented by the United States, Japan, and India, respectively; and (3) bias arising from aggregating commodities by the prices of one of those representative countries will be cancelled out by taking the geometrical mean of three such series. Needless to say, it is arbitrary to assume the three stages (why not four?) and to represent the three stages by the United States, Japan, and India. It is the availability of data, rather than theory, that forced us to set the above assumptions. Readers can obtain more detailed information upon request to the author.

[4] The farm-gate prices of the United States are mainly taken from [27]; those of Japan, from unpublished data prepared for the estimation of farm output in Japan by the Research Division, Minister's Secretariat, Ministry of Agriculture and Forestry. The farm-gate prices of India are either taken from [9] or estimated from the wholesale and retail prices in [7, 8]. The import prices are calculated from [21].

[5] Quantity data for the output of fisheries in the tons of fish catches and in the numbers of whales caught are from [22] and those for the forestry output in the round-wood basis from [23]. Price weights are from [10, 11, 12].

cation of the land variable assigns equal weights to arable land and pasture land in the aggregation. In the course of analysis we will test the adequacy of this specification.

Fertilizer was measured as the sum of N, $P_2 O_5$, and k_2O in metric tons contained in commercial fertilizers consumed [19]. The only available data of international comparability for farm machinery were the total horse power of farm tractors.[6]

We prepared two sets of data for the levels of education: (1) literacy ratios and (2) school enrollment ratios for the first and second levels of education, adjusted for the different lengths of schooling in various countries. The former are the estimates by UNESCO for the mid-20th century [25, pp. 38-44]; the latter, averages of 1950, 1955, and 1960 figures from UNESCO [26]. By taking averages for the three years in five-year intervals, we tried to convert the school enrollment ratio, which is an indicator of increase in education, to the measure of stock of education. It is granted that neither the literacy ratio nor the school enrollment ratio is the direct measure of the levels of education of farm labor population. At best, they are rough proxies of "average education" per farm worker. There seems no *a priori* reason, however, to assume that those proxies move systematically apart from the movements in the average educational level of farm workers so as to cause serious bias in the estimate of education coefficients. As the measure of RDE, we took the 1958-62 averages of the numbers of graduates from agricultural faculties in the third level of education per 10,000 farm workers.[7] This is again a proxy. However, high correlation could be expected between this variable and the number of persons engaged in agricultural research, development and extension activities.

These data are all very crude. It would be extraneous to say more about nonconventional inputs. The inputs of conventional factors are measured in physical terms, and no value weighting was attempted in aggregation to adjust for heterogeneity in inputs. This could be especially crucial in the case of land. Also, no adjustments were made for the degrees of utilization of labor and machine. Given the crudeness of the observations, adequacy of the data specifications should be judged in terms of the results of analysis.

Ordinary least squares were applied to the estimaion of the Cobb-Douglas production function. Problems relating to the estimation of production function from cross-sectional data are well documented in Griliches [3, 5] and need not be repeated here. Because of the lack of data, we would largely be disclaimed for not testing alternative model specification and estimation techniques. In our case, it is likely that bias arising from specification error, if any, is more crucial than the one arising from the inappropriate choice of estimation technique.

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[6] The data are given for OECD countries in [13]; for countries outside of OECD, the total horse powers of farm tractors are calculated from the numbers of farm tractors in [19] by assuming that the average H.P.'s of tractors and garden tractors are 30 and 5, respectively.

[7] Calculated from UNESCO [26].

Estimation of Production Function

The main results of the estimation of aggregate production function are summarized in Table 1. Considering the crudeness of the data, it is rather surprising that the estimated equations fit to the data so well and that the coefficients are as significant as they are. The coefficients remain fairly stable when education and RDE variables are added or subtracted, although the coefficients of land and machinery tend to move in opposite directions. The matrix of simple correlation coefficients among the variables is shown in Table 2. The intercorrelations among explanatory variables are not serious although, of course, the correlation between the educational variables, E_1 and E_2 is very high. It seems that we do not have to worry too much about the problem of multicolinearity.

The plausibility of the estimates in Table 1 can be judged in terms of the estimates of aggregate production function of various countries. Griliches' study [5] indicates that the production elasticities of U.S. agriculture range from 0.4 to 0.5 for labor, from 0.1 to 0.2 for land and fertilizer, from 0.1 to 0.3 for machinery, from 0.3 to 0.5 for education (or labor education) and from 0.04 to 0.07 for research and extension. On the whole, Griliches' estimates and those in this study coincide surprisingly well, despite the completely different sets of data used. Yuize has estimated the aggregate agricultural production function of Japanese agriculture for 1952-62 on cross-regional data [29]. His estimates of production elasticities of labor and land on a value-added basis are within the ranges of 0.4 to 0.6 and 0.2 to 0.4, respectively. Those estimates are consistent with the results of this study since the ratio of value added to gross output is around 0.7 in Japanese agriculture [12]. For the less developed countries we do not have the comparable estimates of aggregate agricultural production function. T. W. Schultz, however, has estimated the production elasticity of labor in Indian agriculture on the observations of influences of the 1918-19 influenza epidemic [14, pp. 58–70]. His estimate of labor's coefficient was 0.4, which is consistent with ours.

It is an interesting finding of Griliches that in U.S. agriculture percentage increase in education, which improves the quality of labor, has the same output effect as percentage increase in labor itself [3, 5]. In order to test whether the same assertion holds in international dimension, we have estimated the production function by combining labor and education variables in a multiplicative form. Combining the variables brought little change. Furthermore, analysis of variance by using F-statistics provided evidences in support of the equality in the coefficients of labor and education.[8]

Sums of the estimated coefficients of conventional factors are not significantly different from one. We cannot discuss internal scale economies (scale economies at farm firm level), as Griliches did for the U.S. agriculture [5], because our data are national aggregates but not measured at per-farm basis. All we can infer is that constant returns prevail at national aggregate levels. This might, however, be one of the distinctive characteristics of agricultural production compared with industrial production and, if so, would have important implication on inter-sectoral investment priority for national economic development.

Theoretically, the regression estimates of economic relations on cross-country data are those of long-run equilibrium. This seems to justify the choice of agricultural land (simple sum of arable land and permanent pasture land) as land variable. It is, however, questionable if this choice of land variable is really adequate. There have been attempts to convert uncultivated pasture land to arable land equivalent with weights more or less arbitrarily chosen [16, p. 154; 28, pp. 7–8]. In this study we tried to estimate the weight in the regression analysis. For the estimation of Regression 1, we defined the land variable as $(A + kS)$, where A, S, and k are respectively arable land area, pasture land area, and the weight to be placed on the latter; and we ran the regression changing k parametrically from 0 to 1. The result was that k converged to 1 with the highest coefficient of determination.[9] A possible interpretation is that the proportion of arable land area to the area of permanent meadows and pastures is a variable determined through adjustments in the method of farming to the demand for agricultural land, and that the production relations estimated on cross-country data are those reached when the adjustments are completed. Economic factors, not climatic, are the dominant factors in determining the intensity of agricultural land use. This is a bold hypothesis, and the present test of it is not yet conclusive. It should be worthwhile to explore this problem in the future.

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[8] The F-statistics calculated for testing the null hypothesis of equality in the coefficients of labor and education are 0.55 for Regression 2 *vs.* Regression 4, 0.03 for Regression 3 *vs.* Regression 5, 0.18 for Regression 6 *vs.* Regression 8 and 0.05 for Regression 7 *vs.* Regression 9.

[9] The coefficients of determination (unadjusted) for various k's are as follows:

k	0	0.05	0.1	0.2	0.3	0.4
R^2	0.9331	0.9368	0.9392	0.9417	0.9430	0.9438
k	0.5	0.6	0.7	0.8	0.9	1.0
R^2	0.9442	0.9445	0.9447	0.9448	0.9449	0.9450

Table 1. Estimates of the aggregate agricultural production function from 38 cross-country observations[a]

Regression number Coefficients of		1	2	3	4	5
Fertilizer	F	0.170 (0.057)	0.180 (0.056)	0.177 (0.060)	0.171 (0.055)	0.174 (0.055)
Machinery	M	0.186 (0.058)	0.111 (0.055)	0.122 (0.056)	0.095 (0.051)	0.119 (0.052)
Land	T	0.176 (0.058)	0.217 (0.053)	0.217 (0.054)	0.229 (0.051)	0.219 (0.052)
Labor	L	0.425 (0.059)	0.455 (0.066)	0.454 (0.071)		
Education[b]	E_1		0.335 (0.190)			
	E_2			0.414 (0.277)		
$L \times E_1$					0.468 (0.064)	
$L \times E_2$						0.459 (0.063)
RDE	U					
Constant term		1.277	0.958	0.957	0.363	0.374
$\bar{R}^2$		0.938	0.979	0.975	0.952	0.952
S.E.		0.1565	0.1389	0.1407	0.1379	0.1386
Sum of coefficients[c]		0.957 (0.042)	0.963 (0.037)	0.970 (0.039)	0.963 (0.037)	0.971 (0.038)

[a] Equations linear in the logarithms of the variables are estimated by least-squares. Data are from [6]. The standard errors of respective coefficients are given in parentheses.

[b] E_1 and E_2 are respectively literacy ratio and adjusted school enrollment ratio.

[c] Sum of coefficients of F, M, T and L (or $L \times E_1$ or $L \times E_2$).

Accounting for the Productivity Gap

On the basis of the production elasticities of various factors estimated in Table 1, we will attempt to account for differences in agricultural output per male worker between the advanced and the less advanced countries. We will compare the United States and India as they represent the two categories of countries. Also, we will compare Japan and India as

Coefficients of \ Regression number		6	7	8	9
Fertilizer	F	0.133 (0.061)	0.158 (0.063)	0.126 (0.058)	0.154 (0.059)
Machinery	M	0.064 (0.061)	0.100 (0.060)	0.053 (0.053)	0.097 (0.057)
Land	T	0.241 (0.053)	0.229 (0.055)	0.248 (0.050)	0.232 (0.054)
Labor	L	0.527 (0.077)	0.482 (0.077)		
Education[b]	E_1	0.460 (0.198)			
	E_2		0.429 (0.278)		
$L \times E_1$				0.538 (0.072)	
$L \times E_2$					0.489 (0.070)
RDE	U	0.109 (0.063)	0.060 (0.062)	0.114 (0.061)	0.059 (0.060)
Constant term		0.286	0.386	0.130	0.268
$\bar{R}^2$		0.954	0.950	0.955	0.952
S.E.		0.1348	0.1408	0.1331	0.1387
Sum of coefficients[c]		0.965 (0.036)	0.969 (0.039)	0.965 (0.036)	0.972 (0.038)

they are more comparable in such conditions as population density and the type of farming.

Differences in output and inputs per worker and in the levels of education and research between the United States and India, and between Japan and India, are measured in percentage terms in Table 3 (last two columns). In order to account for the measured productivity gaps, the following set of production elasticities was adopted with reference to Table 1: 0.45 for labor, 0.20 for land, 0.20 for fertilizer, 0.15 for machinery, 0.45 for education, and 0.10 for RDE. Based on the statistical evidence in

Table 2. Matrix of simple correlation coefficients among variables (in logarithms) used for the estimation of production function in Table 1

		Y	T	L	F	M	E_1	E_2	U
Output	Y	1.000							
Land	T	0.852	1.000						
Labor	L	0.816	0.678	1.000					
Fertilizer	F	0.740	0.456	0.435	1.000				
Machinery	M	0.704	0.658	0.264	0.728	1.000			
Education	E_1	−0.045	−0.131	−0.483	0.538	0.411	1.000		
	E_2	−0.136	−0.222	−0.550	0.500	0.329	0.901	1.000	
RDE	U	0.431	0.325	0.193	0.627	0.481	0.187	0.170	1.000

Table 3. Comparison of farm output and inputs per male worker and of the levels of education and RDE: United States, Japan, and India[a]

		United States (1)	Japan (2)	India (3)	$\frac{(1)-(3)}{(1)}\times 100$	$\frac{(2)-(3)}{(2)}\times 100$
Farm output (wheat units per worker)	Y/L	96.2	10.7	2.22	97.7	79.3
Fertilizer (M. tons per worker)	F/L	2.13	0.32	0.0038	99.8	98.8
Machinery (HP per worker)	M/L	45.9	1.07	0.0077	100.0	99.3
Agricultural land (Ha. per worker)	T/L	129.7	1.43	1.99	98.5	−39.2
Education (percent)	E_1	97	98	18	81.4	81.6
	E_2	101	90	26	74.3	71.1
RDE (graduates per 10 thousand workers)	U	22.8	14.2	0.40	98.2	97.2

[a] Data are from [6].

Table 1, the elasticities of conventional variables are so selected as to add up to unity.

Since our production function is now presumed linear homogeneous in Cobb-Douglas form, we can assume the following approximation formula:

$$\left(\frac{\dot{Y}}{L}\right) = 0.20\left(\frac{\dot{T}}{L}\right) + 0.20\left(\frac{\dot{F}}{L}\right) + 0.15\left(\frac{\dot{M}}{L}\right) + 0.45\dot{E} + 0.10\dot{U} + e$$

where the figures with dots are the percentage differences in output and conventional inputs per worker and in nonconventional inputs (see notations in Table 3) of any two countries, and e is residual. The residual term includes the error due to approximation in addition to the errors involved in the estimation of parameters. Each term in the righthand side of the above equation represents the contribution of each factor to the percentage difference in labor productivity in agriculture. The results of applying the above accounting formula to the percentage differences in output and inputs in the last two columns of Table 3 are summarized in Table 4. Two cases are tried, one using literary rate for educational variable ($E=E_1$); the other, school enrollment ratio ($E=E_2$). The numbers in parentheses measure the relative contributions of respective factors, assuming the percentage difference in labor productivity (the Y/L entry in the last two columns of Table 3) is 100.

Table 4. Contributions of various factors to the international differences in farm output per male worker in percents[a]

Contributions of		United States vs. India		Japan vs. India	
		$E = E_1$	$E = E_2$	$E = E_1$	$E = E_2$
Fertilizer	0.20 $\dot{F}/L)$	20.0 (21)	20.0 (21)	19.8 (25)	19.8 (25)
Machinery	0.15 $(\dot{M}/L)$	15.0 (15)	15.0 (15)	14.9 (19)	14.9 (19)
Land	0.20 $(\dot{T}/L)$	19.7 (20)	19.7 (20)	−7.8 (−10)	−7.8 (−10)
Education	0.45 $\dot{E}$	36.6 (38)	33.4 (34)	36.7 (47)	32.0 (40)
RDE	0.10 $\dot{U}$	9.8 (10)	9.8 (10)	9.7 (12)	9.7 (12)
Residual	e	−3.4 (−4)	−0.2 (0)	6.0 (7)	10.7 (14)
Sum of conventional factors[b]		54.7 (56)	54.7 (56)	26.9 (34)	26.9 (34)
Sum of non-conventional factors[c]		46.4 (48)	43.2 (44)	46.4 (59)	41.7 (52)
Productivity difference $(\dot{Y}/L)$		97.7 (100)	97.7 (100)	79.3 (100)	79.3 (100)

[a] Differences in inputs and output per worker between India and the United States or between India and Japan are measured in percent, with the United States or Japan used for the base: Denoting India by 1 and the United States or Japan by 0, the difference in a variable X is measured as $\dot{X}=(x_0-x_1)/x_0\times 100$. Relative contributions with $(\dot{Y}/L)=100$ are given in parentheses.

[b] $0.20\ (\dot{F}/L)+0.15\ (\dot{M}/L)+0.20\ (\dot{T}/L)$.

[c] $0.45\ \dot{E}+0.10\ \dot{U}$.

Conspicuous difference in the endowment of land relative to labor explains only 20 percent of the productivity gap between the United States and India. Difference in the use of fertilizer accounts for an equal percentage in this productivity gap. Much greater is the influence of education. Education and RDE together explain almost half of the difference in agricultural productivity between the United States and India. The importance of education is more pronounced when Japan is compared with India. Education's contribution to the gap in agricultural productivity between Japan and India amounts to 40 percent, and, together with RDE, amounts to more than 50 percent. The present study indicates India can double her agricultural production only by improving education to its present level in Japan.

Conclusion

In this study, by estimating aggregate agricultural production function on cross-country data, factors have been identified that could influence the level of farm output. With the estimates of production elasticities, the major portion of the enormous difference in the labor productivity of agriculture between the advanced and the less advanced countries has been explained by the factors identified. It was found (1) that differences in the inputs of modern man-made factors account more for the difference in productivity than differences in the endowments of original factors and (2) that education and research are crucial in determining the productivity gap. These findings are consistent with the Schultzian hypothesis that the strategic factors for the transformation of low productive traditional agriculture to highly productive modern agriculture are the new profitable inputs such as chemical fertilizer and the improved varieties of seeds.

We should be cautious, however, in deriving any policy implication from the results of this study. In addition to the problems involved in data and estimation procedures, the present approach has an intrinsic weakness in that the influence of complementarity among factors can not be evaluated. The complementarity could be of particular importance between conventional and nonconventional factors. Improvement in seeds is not effective unless accompanied by increase in the application of fertilizer. Most labor-saving innovations do not materialize without investment in new machinery. The measured contributions of education and research indicate that increases in those nonconventional inputs are required for the less developed countries to close the agricultural productivity gap. But the investment in education and research alone may not bring the measured contribution to output unless it is accompanied by increases in complementary conventional inputs. We can infer that the less developed country can not close the existing productivity gap without investing in education and research to improve the quality of labor and to create better techniques suited for their local environments, but such investment might not be fruitful unless complemented by the efforts to improve the conditions of supply of modern conventional inputs such as fertilizer and machinery. In order to draw a more reliable policy guideline for allocating development efforts, it is necessary to exploit the present approach by improving data and estimation techniques, and, at the same time, to develop an alternative approach that will make it possible to evaluate the complementarity among the production factors.

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A Simulation Study of Population, Education, and Income Growth in Uganda[*]

PHILLIPS FOSTER AND LARRY YOST

Increases in educational level tend to increase income. Higher community income in turn can enable more resources to be put into education. However, increases in population tend to spread scarce educational resources over more children, thereby inhibiting the rise in level of living that can come through increasing the educational investment in each individual. This paper analyzes for a developing economy how changes in birth and death rates affect population growth and educational and economic development. A simulation model of these demographic, educational, and economic processes, based on empirical data from the Buganda tribe in Uganda, is used to study the extent and timing of the responses. Both the method and the empirical results should have relevance for readers concerned with growth and development.

THIS STUDY attempts to clarify the relationship between population growth, expenditure on education, and economic development in an underdeveloped rural economy.

The problem was to estimate, through simulating the growth of a micro-socio-economic system a number of times, the probable impact of differential rates of population growth on the rate of growth of per capita income in a rural community in Uganda. We began with the hypothesis that over an extended period of time, such as 30 years, an inverse relationship exists between the rate of growth of rural population and the rate of growth of its per capita income. Implicit in this hypothesis was the assumption that formal education would play a crucial role in the relationship, should it exist.

A model was developed containing the economic relationships thought to be relevant to the problem. The economic model then became the basis for an econometric model which was used in simulating the behavior of the economy through time. The basic logic of the economic model used in this study borrows heavily from work by Coale and Hoover [1]. The method of simulating the growth of a population through time was suggested by Orcutt [4]. What is methodologically new in this study is the grafting of an economic model of a peasant economy to the population

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simulation technique developed by Orcutt et al. The econometric model that resulted from this fusion uses a combination of the Markov Chain[1] and Monte Carlo techniques.

General View of the Model Used

The model used in this study, diagrammed in Figure 1, has three decision-making components: demographic, educational, and income, each consisting of a set of three decision-making units—individuals, families, the community. Each unit can vary from year to year as status variables, and each participates in the operation of the model in combination with one or more sets of probabilities or functional relationships. As the decision-making components operate and interact through time, they produce outputs that in turn influence the operation and interaction of the decision-making components.

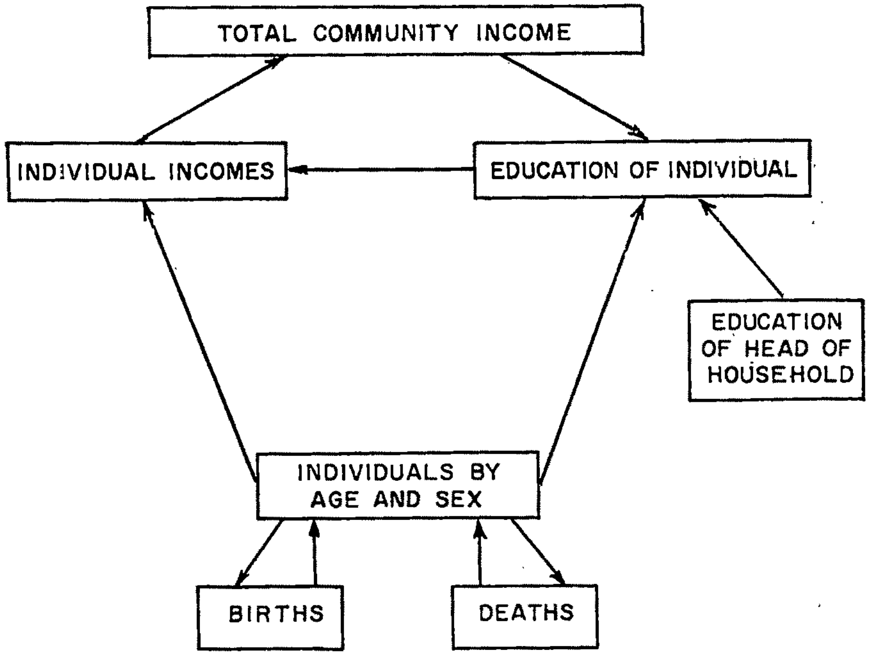

Figure 1. Basic economic model

The demographic decision-making component contains individuals whose status varies by age, sex, marital status, and, for females, the time interval since the last child was born. Changes in age and sex take place each year as births and deaths occur. Birth rates are a function of both the age and sex structure of the population and of the age specific fertility rates[2] of the community. Given a set of birth probabilities, the number of births changes as the age and sex composition of the population changes. Likewise, the number of deaths is dependent upon the age and sex makeup of the population, given a fixed set of death probabilities.

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[1] Individuals in the study community have certain probabilities of moving from one set to another from year to year, within certain constraints.

The educational decision-making component uses all three decision-making units. An individual's educational level is a function of his age and sex, the education of the head of household,[3] and the total community income. The amount of money available for education, which is dependent upon the total community income, is a key constraint on the level of education. Generally, the greater the amount of money available for education, the higher is the level of education attainable in the community, and vice versa.

The income decision-making component of the model is built up from individual income and total community income. An individual's income depends on his education, age, and sex, while total community income is the sum of the individual incomes.

It is the complexity of the interactions among the components of this model through time that makes the simulation technique used appropriate to testing the hypothesis that is the focus of this paper. These interactions generated three major outputs: (1) population structure of the selected community for each year over a 30-year period; (2) annual educational achievement in the community within the estimated demographic, income, and other constraints; and (3) annual incomes in the community, given the estimated demographic, educational, and other constraints.

Each output is affected by the three decision-making units, whose characteristics vary from year to year. Those varying characteristics necessary to our econometric model are called status variables. The year-to-year operation of the model is affected by its annual outputs, such as births, deaths, marriages, etc. The decision-making units and status variables, as well as types of probabilities, functional relationships, and annual outputs used in our model as they are related to the decision-making components, are listed in Figure 2.

The Study Community

Kako community of the Buganda tribe in Uganda was selected for this study. The area, known informally as Kako Hill [2], is located about

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[2] The age specific fertility rate is the total number of live births per 1,000 female population of a given age cohort. This rate can be converted to the age specific birth probability by dividing it by 1,000.

[3] The educational level of the head of any household is not an independent variable, as Figure 1 suggests, but actually depends on other variables that in the past have influenced the education of the individual. These relationships are not indicated in Figure 1, however, in order to keep the diagram relatively simple.

Decision-making component	Decision-making unit	Status variables	Examples of probabilities and/or functional relationships	Examples of annual outputs
Income	Individual	Age Sex Marital status Educational level Income	Income step production function	Individual income
	Community	Population		
Demographic	Individual	Age Sex Marital status Interval since last child	Marriage rules and constraints Sexing probabilities	Births Deaths Family formation
	Community	Age specific birth rates Age specific death rates	Age specific birth probabilities Age specific death probabilities	
Education	Individual	Age Sex Educational level	Starting-school index Staying-in-school index	School entrants School leavers
	Family	Education of head of household		
	Community	Total income Proportion of community income spent on education		Amount spent on education

Figure 2. **Decision-making units, status variables, probabilities, functional relationships, and annual outputs as related to decision-making components**

seven miles northeast of Masaka and 70 miles southwest of Kampala, the capital of Uganda. In 1965, at the time of the field work, 1,677 persons in 423 households lived there, a base population small enough to allow a complete census of the current relevant decision-making units, status variables, and outputs, as shown in Figure 2.

Agriculture provides the economic base for Kako Hill. When the census for this study was taken, over 95 percent of its households were growing at least a few crops, and fewer than one-tenth of the working population worked off the farm. In addition, many of the off-farm occupations were closely related to agriculture. To some extent, the community was an economic enclave, with an estimated per capita income in 1965 of 596 shillings, or $84 [3].

Kako Hill has four schools (one has only grade 1; two have grades 1–8; and one, grades 9–12), with five additional schools (all offering grades 1–6) near its boundary. Residents can send their children through high school without sending them away to boarding school. At the time of our field work, over half the school-age population was in school and 18 percent of the income of the community was being spent on educating its children. The possible age range for the school population was 4 through 29 years; however, the oldest person who actually was in school at the time of the census, or who was simulated to be in school by the model, was a 25 year old person who was in graduate school in India in 1965.

In 1965, Kako's birth rate was 38.5 per thousand people; its death rate, 21.5 per thousand; its population growth rate, 1.7 percent per year.

Decision-Making Components of the Model

As previously indicated, there are three major groups of decision-making components in the model: demographic, income, and educational.

Demographic component

The demographic decision-making component includes death probabilities, birth probabilities, sex probabilities for new babies, selection of women of child-bearing age, and the marriage function.

Sex and age specific death probability tables were prepared for the community from survey data, supplemented by data from the two most recent government censuses. The data in these tables showed the probability of death or of having a baby for persons in 24 age-sex categories.

During the simulation, when an individual was brought into the system for processing, his death probability was selected from the table of death probabilities depending on his age and sex. A random number generator then provided a number between zero and one. If the number was equal to or less than his death probability, he did not die, but was passed on through the other operations of the system.

The birth probabilities furnished the decision-making components that determined when a woman of child-bearing age gave birth. The associated status variables were the woman's age and years since she had her last child. The birth probabilities were calculated as follows:

$$\frac{B_{ij}}{W_{ij}} = P_{ij}$$

where

B_{ij} is the number of women in age category i (i = 10–14, 15–19, 20–24, 25–29, 30–34, 35–39, and 40–50) and years since last child category j (j = 0–2, 3–5, and over 5) who gave birth to a child in 1965;

W_{ij} is the total number of women in age category i and years since last child category j in the population in 1965; and

P_{ij} is the probability that a woman in age category i and years since last child category j will give birth to a child.

The probabilities thus generated were used in the simulation to determine whether a woman gave birth to a child during the year under consideration. The procedure was similar to that used for the "death determination" described earlier.

The sex of each new baby was determined by the use of a sexing probability in combination with the random number generator.

The marriage function required that both the man and the woman be single before either could be considered for marriage and that the man be between 3 years younger and 12 years older than the marriageable woman. This was consistent with the marriage age customs observed during the field work.

Income component

The step production function for income for males not in school is shown in Table 1. Other income production functions were calculated for females not in school, and for males and females in school. The method for estimating farm and off-farm income and for allocating income among individuals is discussed elsewhere [3, p. 11–28]. In the simulation, any individual ten years old or older was processed through the labor force operation. An income was selected for him from one of the income production function tables based on his age, sex, education level, and whether or not he was in school. This income figure was then added to the sum of the incomes of all individuals who had already gone through the labor force operation during that year's run. When every member of the population had been passed through the system that year, the total community income was calculated.

Table 1. Annual incomes for males not in school[a]

Years of schooling of individual	Age of individual					
	10–14	15–19	20–29	30–44	45–65	66 and over
0	114	373	464	558	554	397
1–4	229	628	870	696	527	723
5–8	220	879	1,049	1,728	2,312	1,361
9–12	294[b]	1,417[b]	3,687	2,920	10,107	6,893[b]
13 and over	—	14,486[b]	27,000	15,600	25,600	15,000

[a] Incomes are stated in East African shillings.
[b] Calculated by interpolation or extrapolation.

Educational component

If an individual was between the ages of four and ten and had not yet dropped out of school, a starting-school index number was calculated for him. This index was developed from our survey data and was based on the child's age and the years of schooling of the head of his household. Field data indicated that sex does not seem to influence starting-school probabilities.

The index was calculated as follows:

$$\frac{R_{ij}}{R_{ij} + N_{ij}} = P_{ij}$$

where

R_{ij} is the number of individuals age i ($i = 4, 5, \ldots 10$) who entered school in 1965 and whose heads of households had j ($j = 0$, 1–4, 5–12, and over 12) years of education,

N_{ij} is the number of individuals in the population age i who were not in school in 1965 and whose heads of households had j years of education,

P_{ij} is the index for a possible school entrant age i and whose head of household had j years of schooling.

A staying-in-school index was also calculated, based on field observations relating the student's age and sex and the years of education of his household head. Sex was included as a relevant factor in this index because in Uganda, a girl who reaches senior secondary school is much less likely to remain in school than a boy of the same age with similar family characteristics.

The staying-in-school index was calculated as follows:

$$\frac{R_{ij}^k}{R_{ij}^k + N_{ij}^k} = P_{ij}^k$$

where

R_{ij}^k is the number of individuals sex k (k=male, female,) and age i (i =5–7, 8–10, 11–12, 13–14, 15–16, and over 16), whose heads of household had j (j=0, 1–4, 5–12, and over 12) years of schooling and who were in school in 1965,

N_{ij}^k is the number of individuals sex k, age i, and whose heads of household had j years of schooling who were not in school in 1965,

P_{ij}^k is the index for an individual having the possibility of remaining in school of sex k, age i, and whose head of household had j years of schooling.

During the simulation, when an individual who met the criteria for starting or staying in school came into the system, a starting-school or staying-in-school index was calculated for him. When all individuals in the population had entered the system for that year and those who met the starting-school or staying-in-school criteria had been assigned an index, they were arrayed from the individual with the highest index to the one with the lowest. Individuals were then picked from this array, one at a time, from the highest downward, until the cumulative cost of education for the individuals equalled the amount of money available for education that year. The rest of the individuals in this array either did not enter school that year (if they were potential entrants) or were dropped out of school (if they had been in school last year).

The school costs function was made up of the cost estimates for educating a student for one year in each of grades 1–21.[4] It was assumed that a few students would go on to college, some even to graduate school or professional school, and that much of their support at those levels would come from the local community in which they were brought up.

The money available for education in any year of the simulation was calculated by multiplying the total community income of the previous year by 18 percent, the proportion of community income spent annually for education.

Population Expansion Patterns

Five alternative population expansion patterns were produced by making arbitrary changes in the birth and death probabilities. The first pattern was the result of using birth and death probabilities obtained from the field survey. The simulation production run using these probabilities had an average annual population growth rate of 2.3 percent. (This run was therefore labelled run 2.3; other runs were labelled similarly.) This average population growth rate during the 30-year simulation was higher than the growth rate at the time of the field work because of the relatively large number of females then about to move into the childbearing years (Figure 3). The age structure of the population when our simulation was begun suggests that rate of population growth spurted upwards about 15 years earlier. This could have been due as much to a drop in the infant mortality rate as to an increase in the fertility rates; whatever its cause, the demographic impact of the resulting broadly based population pyramid is evident in each of the simulation runs.[5]

In the second simulation, the death probabilities were arbitrarily lowered enough to reduce the 1965 crude death rate ten points (from 21.5 to

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[4] There were actually 12 grades in the primary through senior secondary school levels. Higher school, college, technical school, and graduate school were considered in the study on the basis of the number of years of school beyond the twelfth grade. Since it was assumed that anyone going on to college and graduate school could finish a Ph.D. or M.D. degree in 9 years or less, 21 years or grades of schooling were assumed possible in the simulation.

[5] The age specific fertility rates for the 20–29 year old females were understandably much higher than for the other age ranges. This, plus the relatively large number of females between 0 and 14 years of age when the simulation began, caused the crude birth rate in the census year to be lower than it would have been for a more "normal" female age distribution with the same set of fertility rates. Therefore, after each simulation had progressed about six years, the relatively large number of females who were in the 0–14 age range during the survey year began moving into the 20–29 age range. The movement of a large number of women into this high birth probability range caused the birth rate to increase. With the death rate fluctuating relatively less than the birth rate, the population growth rate of each simulation began a noticeable increase after the first six years or so of simulation. After some 20 years, the original 0–14 year old cohort of females had moved through or into the 20 to 29 year range and population growth rates started to level off or recede.

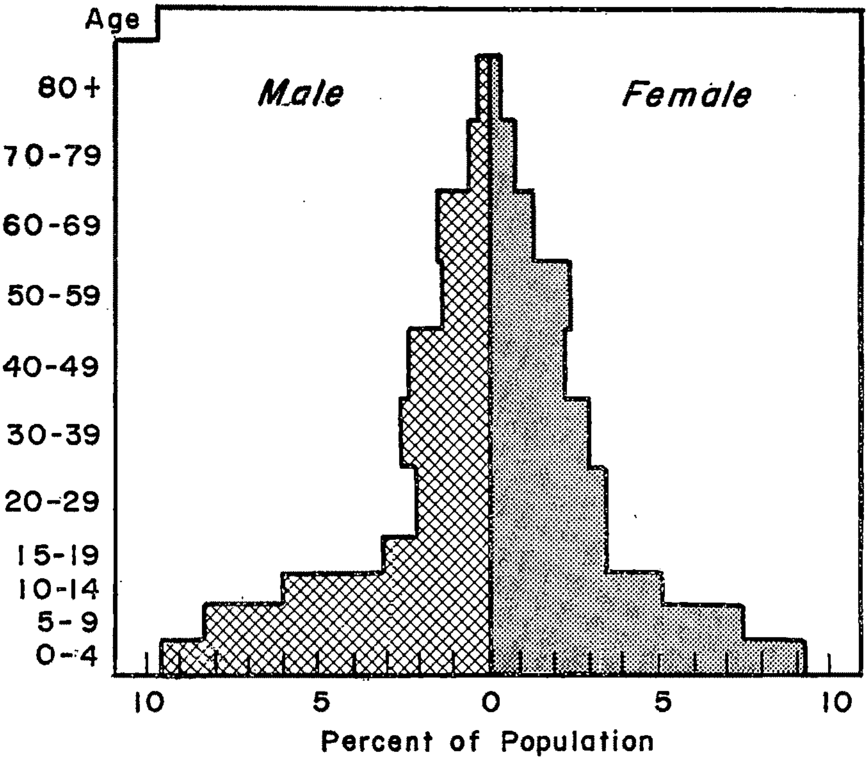

Figure 3. Age-sex pyramid at the start of each simulation

11.5 per thousand).[6] This production run yielded an average annual population growth rate of 2.7 percent.

For the third simulation, the age specific fertility probabilities were arbitrarily lowered enough to reduce the 1965 crude birth rate 10 points (from 38.5 to 28.5 per thousand) and the death probabilities were held at the same level as in the first run. The average annual population growth rate during this 30-year run was 2.1 percent.

The fourth simulation was made using birth and death probabilities associated with base year birth and death rates of 18.5 and 11.5 per thousand, respectively; that is, the 1965 crude birth rate was lowered 20 points and the crude death rate 10 points. This run was to show the simulation output results when population was growing at a low rate. The average population growth rate resulting from this run was 1.2 percent. It should be noted that, although this was the slowest population growth rate of all the simulations, it is still faster than the present population growth rates of Europe and the United States.

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[6] With improvement in nutrition, medical facilities, and sanitation, it is probable that the Kako crude death rate will be reduced to somewhere between 10 and 15 per thousand during the next few years.

For the final simulation, fertility probabilities were increased to yield a 1965 birth rate of 51.5, and death probabilities were adjusted to yield a 1965 death rate of 11.5. These changes were made in order to give a set of birth and death probabilities that would yield a high population growth rate. This run produced a 3.7 percent annual growth rate.

These five runs provided results within a farly wide range of realistic annual population growth rates, from 1.2 to 3.7 percent.

Results of the Simulations

The simulation technique used investigates the relationship between income growth and population growth derived from the following feedback loop: Educational level, age, and sex determine an individual's income and hence the total income of the whole group of individuals; the total community's income is allocated in a fixed proportion to producing educational services for the school age population; the amount of education provided the school age population heavily influences its income after it leaves school. The loop is thus closed. With a different set of birth and death probabilities assigned to each production run, the differential results obtained are attributable to the different ways the population grew.

Total population at the beginning of each simulation was 1,677. At the end of the five simulations, it ranged from a low of 2,379 to a high of 4,632 (Figure 4).

The dependency ratio (proportion of population under 15 years of age) of the five runs varied from 31 percent at the end of 30 years for run 1.2 to 53 percent for run 3.7 (Figure 5). At the end of the sixteenth year the spread was even greater—24 percent versus 52 percent.

All the dependency ratios, except the one associated with the fastest rate of growth of population, experienced a general depression centering roughly on year 15 of the simulation. As explained above, this occurred because the population pyramid with which the simulation began had an especially broad base. Our simulation suddenly stabilized the age specific fertility rates and the result, among the slower growing population simulation runs, was a tendency for the dependency ratio to fall as the "over-sized" younger cohorts moved into older cohort status. Then as these same "over-sized" cohort groups moved into the most fertile child bearing age, they sent the birth rate back up and the dependency ratio thus began moving up again. This phenomenon is depicted clearly in Figure 6, especially in run 1.2 and run 2.1.

The average years of schooling of the community population over the 30 years continually increased for all five runs (Figure 7), but the rate of increase differed. At the end of the 30-year period, the average level

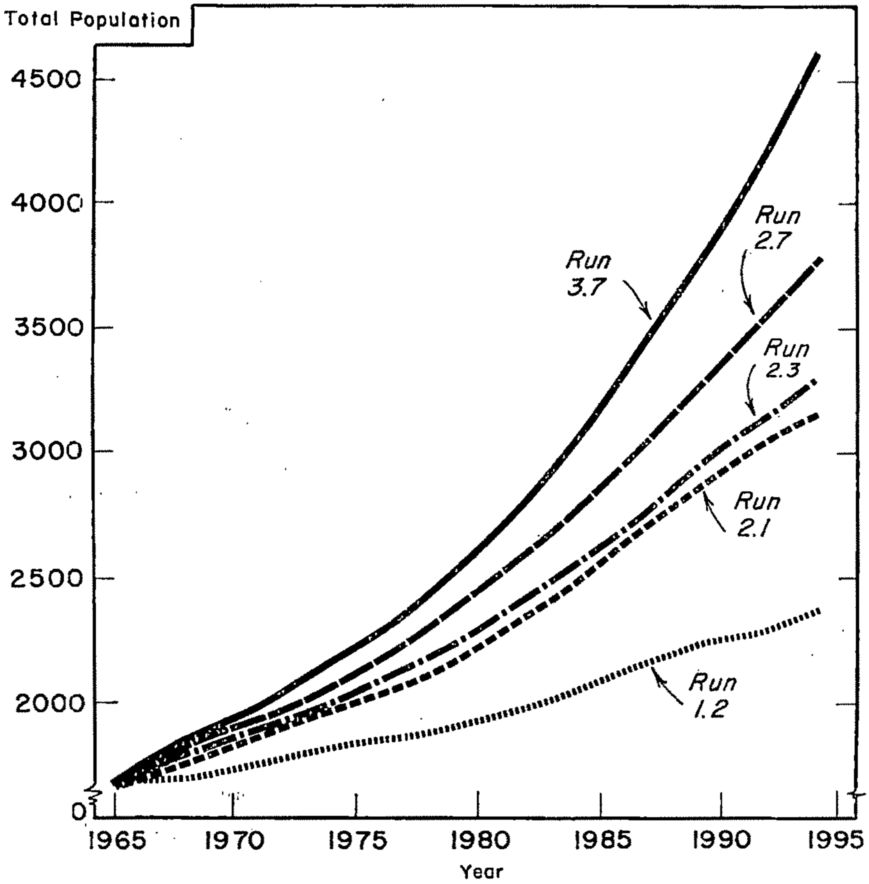

Figure 4. Total population annually for each simulation

of education ranged from a low 5 years for run 3.7 to a high of over 7 years for run 1.2. Using this data, an equation was fitted by least squares. The resulting equation was $y = 4.75 - .50x$; ($R^2 = .93$), where

y is the annual percentage increase in average educational level,[7]

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[7] Annual percentage increase in average education level was calculated by the formula

$$PL = FL/(1 + r)n$$

where

PL = present average educational level,
FL = average education level in year n ($n = 30$),
r = annual percentage increase in average education level, and
n = number of years over which the calculation is made, i.e., years between PL and FL.

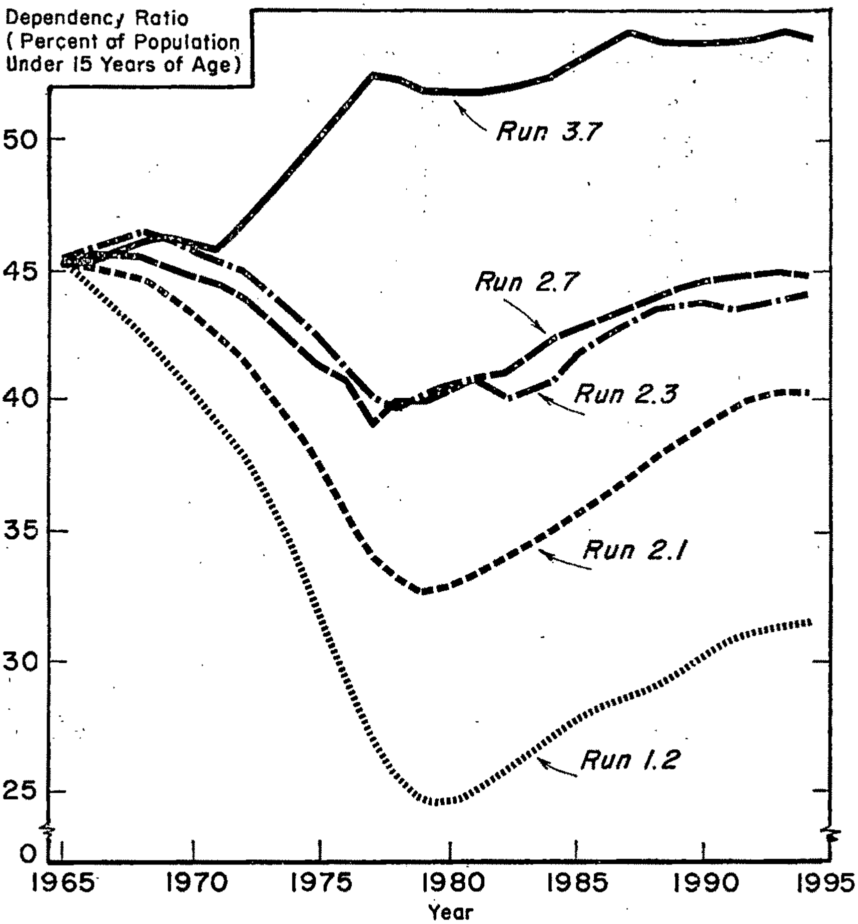

Figure 5. Dependency ratio annually for each simulation

and

x is the population growth rate.

The per capita income increased during each of the five simulations (Figure 8). At the end of the 30 years, it ranged from a low in run 3.7 of 1,429 shillings to a high in run 1.2 of 2,972 shillings.

The percentage increases in annual per capita income (rate of economic development) varied from a low of 3.04 percent (run 3.7) to a high of 5.56 percent (run 1.2). Runs 2.1, 2.3, and 2.7 had increases in annual per capita incomes of 4.93 percent, 4.84 percent, and 4.85 percent respectively.[8]

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[8] These figures were calculated by use of the formula

$$PI = FP/(1+r)n$$

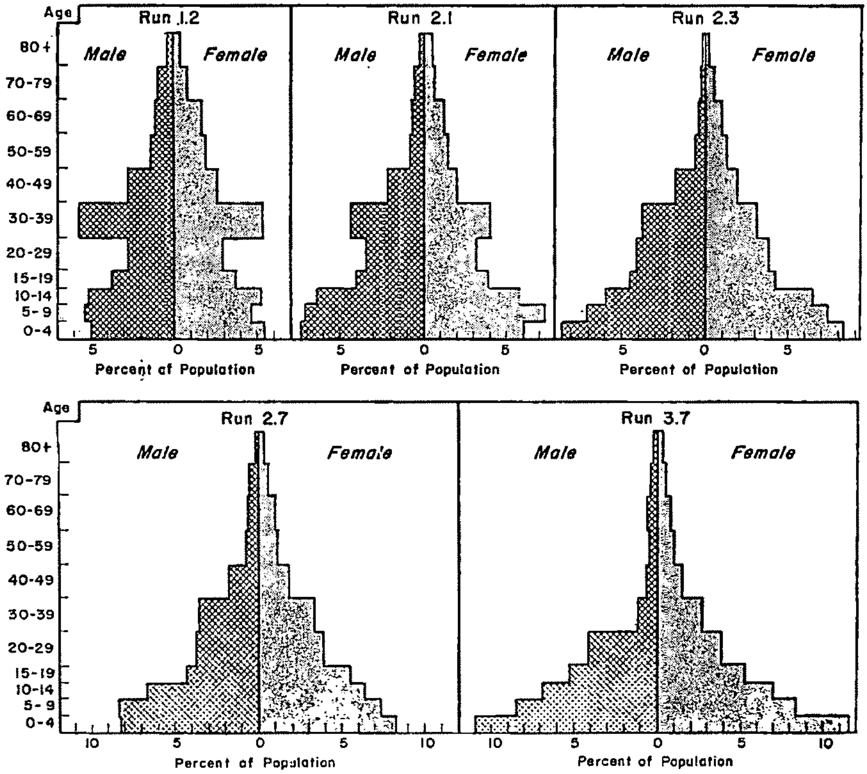

Figure 6. Age-sex pyramid at the end of each simulation

To these results, a function was fitted by least squares. The resulting equation was $y = 6.42 - .98x$; ($R^2 = .88$), where

y is the annual percentage increase in per capita income,

and

x is the population growth rate.

This equation summarizes the most important finding of our study. It suggests that in Kako community in Uganda, over a 30-year period, a reduction in the rate of growth of population from, say, 3 percent annually to 2 percent will, in and of itself, increase the annual rate of growth of per capita income from 4.0 percent to 4.98 percent. Conversely, an increase in rate of growth of population from 2 percent annually to 3 per-

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where

PI = per capita income in year one,
FP = per capita income in year n ($n = 30$),
r = percentage increase in annual per capita income, and
n = the number of years over which the calculation was made.

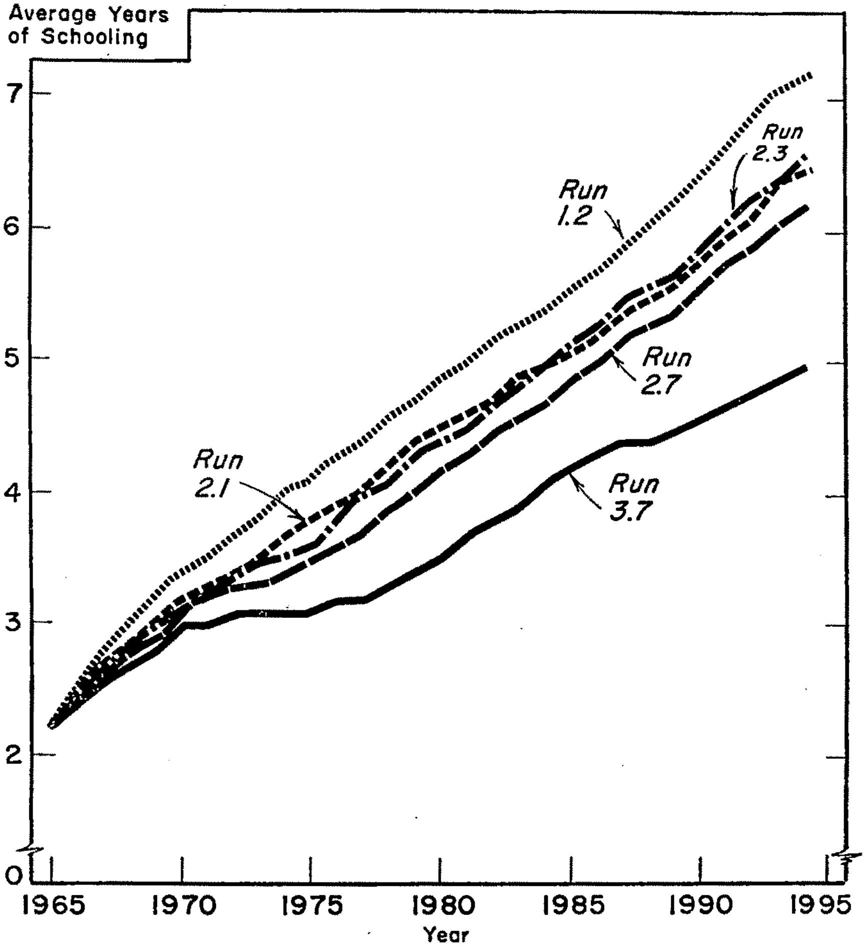

Figure 7. Average years of schooling annually for each simulation

cent annually will result in a decrease in rate of growth of per capita income from 4.98 to 4.0 percent.

Put less precisely, but perhaps more understandably, this equation suggests that, for each percentage point or fraction of a percentage point development planners can reduce the rate of growth of population in this community, they can expect an approximately equal increase in rate of growth of per capita income. Conversely, for each percentage point or fraction of a percentage point development planners allow the rate of growth of population to increase in this community, they can expect an approximately equal decrease in rate of growth of per capita income.

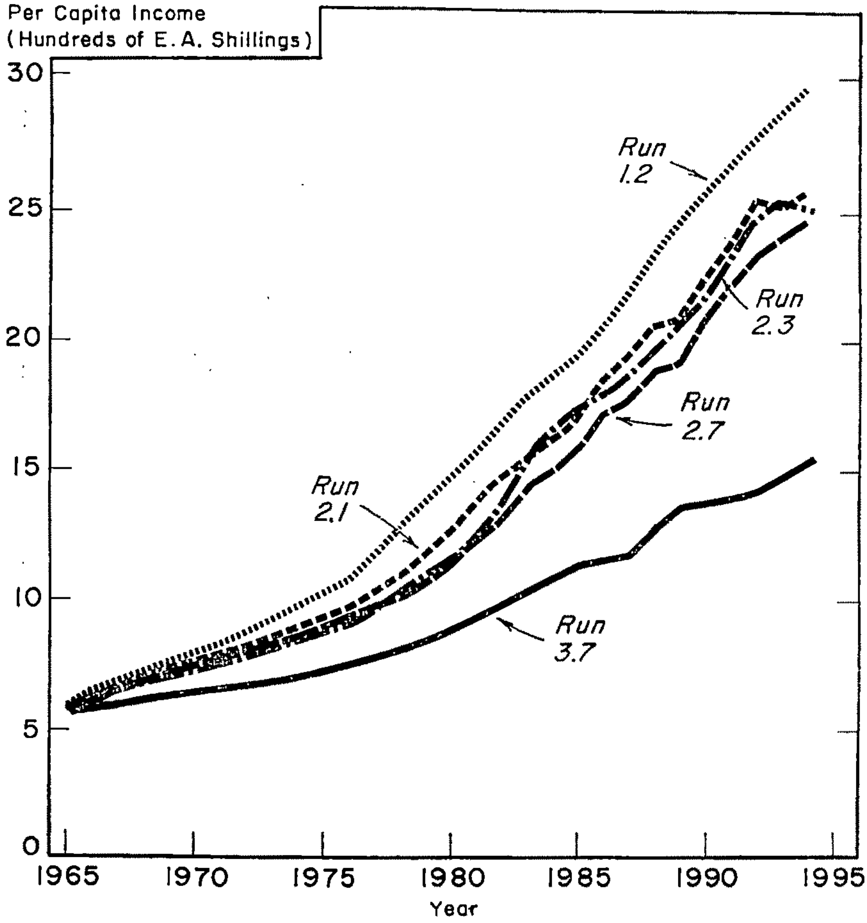

Figure 8. Per capita income annually for each simulation

Summary and Implications

Through time in Kako community in Uganda, a marked inverse relationship apparently exists between population growth rate and rate of increase in per capita income. This relationship seems to be closely associated with the inverse relationship, suggested by our simulation results, between population growth rate and the capacity of Kako community to educate its children. A high population growth rate in this community will probably be seriously deterimental to economic development, its dampening effect increasing in degree as the population growth rate increases.

The econometric model we developed to simulate our economic model through time could be used for a country or regional population on a sample basis. The results from such simulations could have even greater value to economic development planners than our present study. Furthermore, our econometric model can be altered for a number of different research interests and may thus have many possibilities for further use.

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"Disguised" Unemployment Once Again: East Pakistan, 1951–1961*

WARREN C. ROBINSON

The concept of "disguised" unemployment plays an important role in development theorizing, yet its empirical content is uncertain. This paper studies the problem in rural East Pakistan, a densely-populated rice-producing area of South Asia. It is shown, using data on output and workers per acre and cropped acreage, that between 1951 and 1961 the degree of "disguised" unemployment increased sharply, amounting to some 20 percent of the 1961 labor force. This is attributed to the rapid population growth, which had begun two decades earlier, plus the fixed supply of other factors. The labor surplus that developed seems to have been largely "disguised" through work-sharing, that is, a reduction in average hours worked per worker.

DISGUISED" or "hidden" unemployment is one of the most fundamental concepts in development literature. Rosenstein-Rodan [33], Nurkse [22], Lewis [17], and Fei and Ranis [7] have assigned it a key role in interpreting economic backwardness and in suggesting how development can best be promoted through public policy. Yet a surprisingly small number of empirical investigations into the matter have been attempted, and these have not always supported the a priori theoretical assumption. Indeed, Kao, Anschel, and Eicher concluded that "to date, there is little reliable empirical evidence to support the existence of more than token—5 per cent—disguised unemployment in underdeveloped countries . . ." [14, p. 141].[1] On the other hand, the recent rather careful analysis of South Korea by Young Sam Cho finds a considerable amount of disguised unemployment [5]. Thus, the empirical results are contradictory.

This paper provides additional empirical evidence bearing on this question. More specifically, it attempts to construct the average and marginal product curves of agricultural labor for the province of East Pakistan for 1951 and 1961. The approach is an indirect one, using data on labor force, value of output, and cropped acreage. Our principal conclusion is that the product per marginal laborer in East Pakistan agriculture was positive in 1951, but that between 1951 and 1961 there developed an incremental "surplus" of about 20 percent of the labor force, in addition to whatever

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[1] Jorgensen's recent survey of empirical results reaches the same conclusion [13, pp. 48–52].

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degree of surplus existed prior to 1951. The reconciliation of a growing surplus of workers with a positive marginal product was probably effected through decreases in the average work-week (hours worked per worker).[2]

A Brief Description of East Pakistan[3]

East Pakistan, one of the two provinces of Pakistan, is organized into 17 districts. Virtually the entire province is built-up alluvial deposits of the Ganges, the Brahmaputra, and the Meghna rivers, and their innumerable tributaries and branches. Its climate is tropical monsoon; its major crops, rice and jute, which are grown in nearly every district. There is considerable homogeneity in the physical land base and the structure of agriculture all across the province.

According to the 1961 census, nearly 80 percent of the agricultural labor force is made up of owner-cultivators or unpaid family labor. Some 95 percent of East Pakistan's 50 million people live in some 65,000 villages. In spite of its rural character, East Pakistan is densely settled. Its overall density approaches 1,000 per square mile, but two districts had 1961 densities of about 1700 per square mile. Population growth in East Pakistan has been rapid in the recent past. Although registration data on births and deaths is lacking, the 1951 and 1961 census data implied an annual average growth rate of over 2 percent. Moreover, there is evidence that the death rate has been falling while the birth rate has not, so that the growth rate may now be 3 percent per annum.[4] An ambitious family planning program has been launched, with government support, but no tangible results have yet appeared.

In summary, East Pakistan is made up for the most part of illiterate peasant cultivators who own their own land, live in small villages, and grow mostly rice, using their own labor. The area is densely settled and population is growing rapidly. Based on the conditions that generally are assumed to generate or at least to be associated with "disguised" unemployment, one would expect to find "surplus" labor in East Pakistan if it is to be found anywhere in the developing world.

Data and Methods Employed

Our data consist of (a) the agricultural labor force in East Pakistan for 1951 and 1961; (b) value of output in constant prices (1959–1960) for the major crops of the province; and (c) cropped acreage in East Pakistan for 1951 and 1961. Since these data were available by district, we have 17 observations for each year. Though limited, they make possible a cross-sectional analysis of the relationship between output and the two major inputs, land and labor. By expressing output and labor input on a per acre basis, it is possible also to estimate the average and marginal product functions of labor, land held constant.

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[2] John Mellor has suggested that labor force may be thought of as the "stock" while man hours utilized should be seen as the "flow." Considerable confusion has arisen in the literature because of a failure to make this distinction [19].

[3] This section is based on the 1961 Census Report Summary [24] and on Professor Ahmad's authoritative volume [1].

[4] The growth rate may well be higher than this; see [15].

This approach assumes implicitly that the production relationships in the 17 separate districts are similar and that each district can be seen as an observation generated by a single provincewide production function. To the extent that production relationships in each district are not homogeneous, one would be troubled by our approach. More generally, this homogeneity problem arises whenever cross-sectional data are employed in estimating functional economic relationships, and there is no easy answer [9]. However, the objective evidence—soil types, rainfall, population density, crops grown, and so on—supports the assumption of underlying homogeneity of the production functions in the districts of East Pakistan [24, Ch. I; 27, Pt. I].

The major conceptual weakness of this approach is the absence of a figure for capital stock in both 1951 and 1961. However, this weakness may not be as serious as it appears at first glance. First, there is a general acceptance of the notion that capital in the usual Western sense (machinery, chemical fertilizers and pesticides, purchased seed, and so on) is unimportant as an input in the typical labor-intensive peasant agriculture situation of South Asia.[5] Capital there consists mainly of simple tools, built and maintained by the farmer himself, or of draft animals that also are locally "produced." Since these capital inputs probably change only as land under cultivation changes, we argue that land in our analysis is actually a surrogate for land-plus-capital. Second, there is the reassurance that the period 1951 to 1961 in East Pakistan was one of almost complete technological stability; that is, no major changes in technique, factor proportions, or level of investment seem to have occurred.[6]

Our labor force figures come from the 1951 and 1961 censuses, which differed in coverage and definition. The beginning labor force age was 10 years in 1951 and 12 years in 1961, requiring an adjustment of the 1961 data for our purposes.[7] Cropped acres and value of output are estimates compiled by the Provincial Department of Agriculture [28] and undoubtedly include many rough estimates. The physical output series were converted into value terms by multiplying them by the appropriate farm wholesale price indexes (again, as compiled by the Department of Agriculture), and the resulting value series was then expressed in constant prices, using the index of wholesale prices compiled by the Central Statistical Office. These prices and index series also undoubtedly contain many possible sources of error.

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[5] Mellor writes: "The two prime inputs of traditional agriculture are land and labor. Capital is not only much less important in quantity, but also it is largely a direct embodiment of labor in the form of land improvements, water system and simple tools" [19, p. 37]. See also Mathur [18, p. 189]. Rao [31, p. 48] shows that in neighboring West Bengal in the middle 'fifties only about 18 per cent of gross value of output went to purchased inputs of all types, including bullocks and seed.

[6] Falcon and Gotsch write of the period under review as ". . . a stagnant era between Partition and the end of the First Plan Period . . ." [6, p. 31]. See also [21, pp. 243–244].

It can be argued that one should use as price weights the international price for the various crops, thus eliminating any distortions between 1951 and 1961 due to tariffs, domestic price controls, or temporary price movements occasioned by exogenous factors such as weather. However, fundamentally we are interested in the relative levels of 1951 and 1961, not in the absolutes, as we would be, for example, for international comparisons; and there is no evidence that the degree of price distortion for various commodities (compared with international prices) had changed between 1951 and 1961.

Finally, our total value of output represents, in fact, the output of rice, jute, and the other important crops. About 96 percent of the total cropped acreage is accounted for in the physical outputs underlying the value series. The unaccounted for residual component consists for the most part of minor food crops. We have no reason to think that including this element in our output series would affect trends or major conclusions.

Results and Interpretation

Table 1 presents yields per acre, by district, for 1951 and 1961. Average yield per acre rose from 210 rupees in 1951 to 240 rupees in 1961. The rapid increase in population was reflected in an increase from .41 to .51 in workers per cropped acre (Table 2). This ratio had apparently been quite stable in the .35 to .40 range prior to the 1951 census for a fairly long period of time.[8] The increase in workers per acre was also more uniform than changes in yield per acre. In 15 of the 17 districts, workers per acre increased; in one district there was no change; and in only one was there an apparent decrease in workers per acre.

Since we lack any measure of labor in man hours, our measure of marginal product of labor must be the changes in output per worker as

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[7] Bean et al. [2] suggest further that, because of a change in the census question, unpaid female agricultural workers were more completely enumerated in 1961 than in 1951. The point is debatable, however, and we have made no adjustment for it.

[8] Thus, Blyn [3, p. 207] shows the following worker-per-acre ratios for greater Bengal: 1901–.385; 1911–.391; 1921–.415; 1931–.396. Our 1951 figure of .41 is quite consistent with these earlier data.

Table 1. Yield per acre, by districts, East Pakistan, 1951 and 1961

Code	Districts	1951			1961		
		Cropped area (acres)	Gross value of output[a]	Yield per acre[b]	Cropped area (acres)	Gross value of output[a]	Yield per acre[b]
—	East Pakistan	26,250,625	5,503,000	210	27,592,050	6,620,000	240
1	Chittagong	867,430	154,085	178	1,001,508	176,195	176
2	Chittagong H.T.	265,775	48,613	183	251,990	43,338	172
3	Comilla	1,851,480	399,788	216	2,064,235	489,357	237
4	Noakhali	1,074,245	194,236	181	950,420	218,333	230
5	Sylhet	1,931,535	368,207	191	2,072,055	559,244	270
6	Dacca	1,858,405	339,617	183	1,746,300	509,336	292
7	Faridpur	1,582,815	314,470	199	1,907,900	353,652	185
8	Mymensingh	3,866,280	757,414	196	4,087,052	1,195,428	292
9	Barisal	2,182,245	372,773	171	2,487,000	503,762	203
10	Jessore	1,369,485	277,959	203	1,347,500	264,032	196
11	Khulna	1,469,285	258,383	176	1,185,600	239,036	202
12	Kushtia	844,285	147,056	174	829,800	154,384	186
13	Bogra	913,675	202,391	222	944,885	204,260	216
14	Dinajpur	1,172,050	268,352	229	1,209,160	256,384	212
15	Pabna	1,156,015	289,376	250	1,070,700	191,210	179
16	Rajshahi	1,723,465	285,269	166	2,162,613	458,246	212
17	Rangpur	2,122,155	488,831	230	2,273,332	501,416	221

[a] Thousands of 1959–60 rupees.
[b] Rupees.
Source: [26, 27, 28, 29].

Table 2. Agricultural workers per cropped acre, by districts, East Pakistan, 1951 and 1961

Code	Districts	1951			1961		
		Cropped area (acres)	Agricultural labor force	Workers per cropped acre	Cropped area (acres)	Agricultural labor force	Workers per cropped acre
—	East Pakistan	26,250,625	10,715,467	0.41	27,592,050	14,336,496	0.51
1	Chittagong	867,430	514,335	0.59	1,001,508	735,634	0.73
2	Chittagong H.T.	265,775	86,834	0.33	251,990	182,185	0.72
3	Comilla	1,851,480	993,487	0.54	2,064,235	1,827,152	0.89
4	Noakhali	1,074,245	563,007	0.52	950,420	780,230	0.82
5	Sylhet	1,931,535	948,416	0.49	2,072,055	1,129,362	0.55
6	Dacca	1,858,405	944,083	0.51	1,746,300	915,630	0.52
7	Faridpur	1,582,815	658,566	0.42	1,907,900	785,118	0.41
8	Mymensingh	3,866,280	1,665,411	0.43	4,087,052	2,384,721	0.58
9	Barisal	2,182,245	888,414	0.41	2,487,000	1,017,250	0.41
10	Jessore	1,369,485	425,692	0.31	1,347,500	543,227	0.40
11	Khulna	1,469,285	524,840	0.36	1,185,600	582,831	0.49
12	Kushtia	844,285	180,403	0.21	829,800	269,637	0.32
13	Bogra	913,675	310,363	0.34	944,885	404,452	0.43
14	Dinajpur	1,172,050	356,319	0.30	1,209,160	520,590	0.43
15	Pabna	1,156,015	334,424	0.29	1,070,700	420,278	0.39
16	Rajshahi	1,723,465	560,055	0.32	2,162,613	713,953	0.33
17	Rangpur	2,122,155	760,818	0.36	2,273,332	1,124,246	0.49

Source: [24, 25, 26] and Table 1.

changes occur in average workers per acre of land. In view of the rather small number of observations available to us and their wide dispersion, we have resorted to a "smoothing" technique in an effort to bring out the underlying relationships. The average product per worker, as shown by our data (Table 3), was plotted against the corresponding values of workers per acre. A least-squares linear function was then fitted to these data, and the "expected" values of average products read from this function (Table 4). The marginal products per worker were then derived on

Table 3. Output per worker, by districts of East Pakistan, 1951 and 1961

Code	Districts	1951			1961		
		Agricultural labor force	Gross value of output[a]	Productivity per worker[b]	Agricultural labor force	Gross value of output[a]	Productivity per worker[b]
1	Chittagong	514,335	154,085	300	735,634	176,195	240
2	Chittagong H.T.	86,834	48,613	560	182,185	43,338	238
3	Comilla	993,487	399,788	402	1,827,152	489,357	268
4	Noakhali	563,007	194,236	345	780,230	218,333	280
5	Sylhet	948,416	368,207	388	1,129,362	559,244	495
6	Dacca	944,083	339,617	360	915,630	509,336	556
7	Faridpur	658,566	314,470	478	785,118	353,652	450
8	Mymensingh	1,665,411	757,414	455	2,384,721	1,195,428	501
9	Barisal	888,414	372,773	420	1,017,250	503,762	495
10	Jessore	425,692	277,959	653	543,227	264,032	486
11	Khulna	524,840	258,383	492	582,831	239,036	410
12	Kushtia	180,403	147,056	815	269,637	154,384	573
13	Bogra	310,363	202,391	652	404,452	204,260	505
14	Dinajpur	356,319	268,352	753	520,590	256,384	492
15	Pabna	334,424	289,376	865	420,278	191,210	455
16	Rajshahi	560,055	285,269	509	713,953	458,246	642
17	Rangpur	760,818	488,831	643	1,124,246	501,416	446

[a] Thousands of 1959–60 rupees.
[b] Rupees.
Source: Tables 1 and 2.

the basis of these "expected" average values. Thus, our average and marginal products are, in effect, "smoothed" estimates based on the data but giving more weight to the mean values of the distribution and less weight to the extreme cases.[9] Where P = output per worker, l = workers per acre, and Y = output per acre, our implicit production relationships are:

$$P = f\,(l) \text{ and } Y = P \times l$$

Since we define for our estimation equation:

$$P = \alpha - Bl$$

then we are assuming:

$$Y = l\,(\alpha - Bl) = \alpha l - Bl^2.$$

The results are interesting and quite plausible. They suggest that for 1951 and 1961 both the average and marginal product per worker fall continuously and rather sharply (Figures 1 and 2). Comparing 1951 with 1961, the average product per worker seems to have fallen from about 514 rupees to about 452 rupees, while workers per acre were rising from about .41 to .51. Within these overall changes there are some interesting differences. In 1951 marginal products ranged from about 384 to minus

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[9] Our actual observations show a rather large amount of dispersion around the fitted least-squares lines. The standard errors of estimate ($S_{1.2}$) are: 1951—74.321; 1961—59.968. Combined with the means shown in Table 4 (1951—514; 1961—452), these yield indexes of relative dispersion (V) of: 1951—14.32; 1961—13.26. On the other hand, there is a significant relationship between the underlying variables, workers per acre and output per worker. The correlation coefficients (r_{12}) are: 1951—.7917; 1961—.7285. These are significant at the .05 level (N = 15).

Table 4. Actual and estimated output per worker, by districts, East Pakistan, 1951 and 1961

District code	1951			
	Workers per acre (Y)	Actual output per worker[c]	Estimated output per[a] worker[c] (P)	Estimated marginal output per worker[c]
12	.21	815	803	
15	.29	865	687	383
14	.30	753	673	253
10	.31	653	658	225
16	.32	509	644	195
2	.33	560	630	166
13	.34	652	615	138
11	.36	492	586	94
17	.36	643	586	94
9	.41	420	514	− 74
7	.42	478	499	− 94
8	.43	455	485	−123
5	.49	388	398	−224
6	.51	360	379	− 85
4	.52	345	355	−894
3	.54	402	326	−427
1	.59	300	253	−528
East Pakistan	.41	514		
	1961			
12	.32	573	565[b]	
16	.33	642	559	400
15	.39	455	523	320
10	.40	486	517	310
7	.41	450	511	300
9	.41	495	511	300
13	.43	505	499	250
14	.43	492	499	250
11	.49	410	463	200
17	.49	446	463	200
6	.52	556	445	167
5	.55	495	428	150
8	.58	501	410	100
2	.72	238	326	25
1	.73	240	320	20
4	.82	280	266	−136
3	.89	268	224	−270
East Pakistan	.51	452		

[a] $P = 1107.17 - 1447.40\ (Y)$.
[b] $P = 756.93 - 598.85\ (Y)$.
[c] Rupees.
Source: Tables 1, 2, and 3

528. Marginal product became negative at about 550 average product and when about .40 workers per acre were employed. In 1961 the average and marginal functions have both flattened out and shifted slightly to the left, with the result that the marginal product distribution has less range (from about 400 to minus 270) and fewer negative values. The marginal products become negative when some .75 workers or more per acre are employed or when the average product is about 300 rupees per worker.

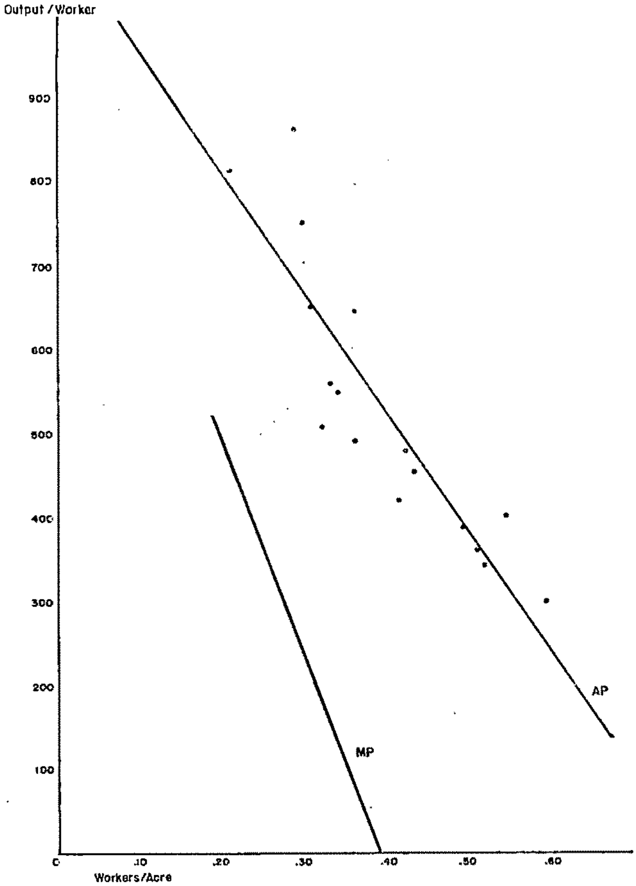

Figure 1. **Average and marginal productivity of agricultural workers. East Pakistan, 1951**

"Work-sharing" as an explanation

The nature of the shift in both average and marginal functions suggests an interpretation that is consistent with what one might expect to occur in a small-scale, family-centered, peasant agricultural sector subjected to rapid population growth. Thus, let us assume that the pre-1951 setting in agriculture was "efficient" in the sense that cultivators were applying about the "right" amount of labor (measured in man hours) per acre, given the technology of production. The average work week (hours worked per worker) would have been optimal even though perhaps below a Western-style "normal" work week (thus implying already existing "disguised" unemployment). Assume that all additional workers "claim" at least a subsistence share of total output because of family ties. Assume

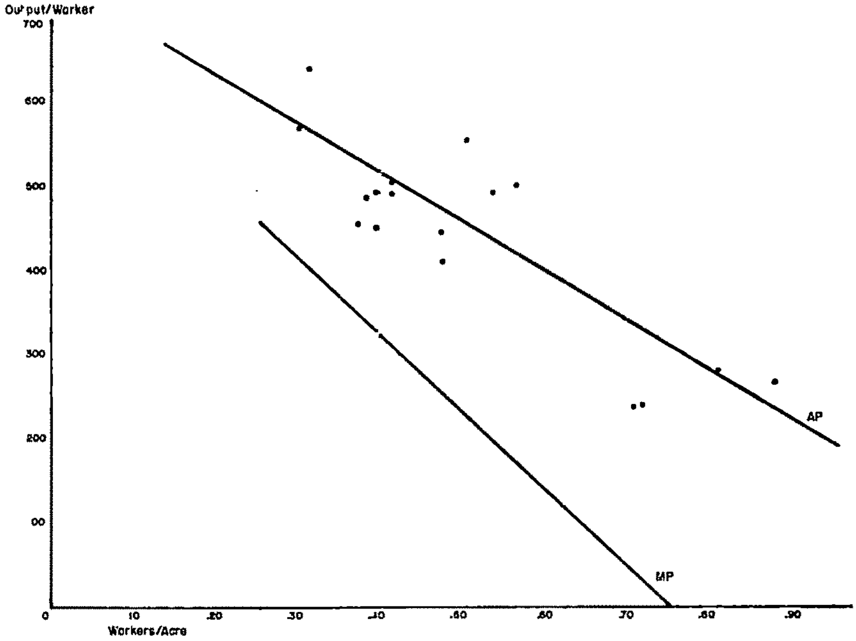

Figure 2. **Average and marginal productivity of agricultural workers, East Pakistan, 1961**

further that leisure has a positive value to the cultivators, so that, given a choice of working longer or shorter hours for the same income, they would prefer shorter hours. In this situation, any increase in workers will reduce the average hours worked per worker, as well as the average product per worker, even while not affecting the average product per man hour or per standard man day. Disguised unemployment would increase. "Work-spreading" would occur so that the marginal product per worker remained positive even while the number of workers increased. This would show up graphically as a "flattening out" of the average and marginal product functions of labor over time as hours of work per worker fell. Only when numbers of workers had increased to such an extent that average product per worker was approaching marginal product and both were near the subsistence level would further "work-spreading" become impossible. Past this point, either negative (or at least below subsistence) marginal products would begin to appear or the institutional arrangements under which added workers were guaranteed a claim against output would begin to break down and overt unemployment appear.

This interpretation is plausible and consistent with the results obtained above for East Pakistan.[10] The period of rapid natural population increase in East Pakistan dates back only to the thirties when death rates began to fall slowly. It would probably have required several decades for the population growth to have begun to build up enough to affect the man/land ratios. However, by 1951, the stable "efficient" factoral balance in agriculture was disturbed. The negative marginal products per worker actually observed can thus be seen as an accidental result of too many laborers (and too many labor hours) being applied to the land. By 1961, however, an adjustment—even to the continuing population pressure—had occurred and a new "efficient" employment of the existing labor force had come about through a reduction in hours worked per worker.[11]

It should also be noted that some genuine labor *intensification* per acre may have increased because of exogenous changes, such as an incentive effect created by the land reform of 1958,[12] or changes in non-labor inputs, such as increased irrigation in the dry season, or more use of fertilizers. However, if some "surplus" already existed because of previous work-sharing practices, then labor intensification could have occurred in response to the exogenous changes even without the growth in the labor force.

Extent of disguised unemployment

What do these results imply about the magnitude of "disguised" unemployment in East Pakistan in 1951 and 1961? During that decade the total labor force grew by 3.6 million. Cropped acreage grew by 1.3 million which, given the 1951 workers per acre ratio of .41, required only 600,000 new workers. The additional 3 million new workers actually employed increased the workers per acre ratio to .51 and decreased the average product per worker. Had the 1951 relationships between labor inputs and output per worker (the average and marginal product curves per acre) also held for 1961, the actual 1961 workers per acre ratio of .51 would have resulted in a province-wide average product per worker of about 360 rupees and a total output of about 5,200 million rupees, or a drop of about 20 percent from the actual 1961 total output. Since the average workers per acre ratio in 1951 of .41 was also the point at which negative marginal products began to occur, one can argue that the entire 3 million workers added between 1951 and 1961 were surplus. This would amount to some 20 percent of the 1961 labor force.

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[10] This interpretation also receives some indirect support from surveys conducted in East Pakistan in 1961. Nurul Islam, summarizing these, writes: "With a smaller size of holdings per head, i.e., with a larger working population per acre, less time seems to be spent per head on the farms and thus more workers can be accommodated per acre. This may indicate a certain amount of work spreading to provide employment for a larger active population . . ." [12, p. 249].

[11] A. K. M. Ghulman Rabbani [30] has studied the problem of underemployment in East Pakistan using a completely different approach. Using a standard man-day of eight hours and an estimate of marginal productivity per man-day, Rabbani calculated the output of rise in East Pakistan in 1964–65. This was then compared to the actual labor available and on this basis . . . "it is seen that nearly 40% of the labour employed . . . was surplus . . ." [30, p. 241]. These results are not inconsistent with those reached here. Our major point is that the magnitude of the true "surplus" is "disguised" by a shift in the average hours worked per worker so that the "required" labor inputs are furnished by all the "available" laborers.

[12] The land reform in question did not result in a radical break-up of large-scale estates with the consequent risks of a drop in output. Instead, it chiefly vested ownership rights in the small-scale cultivators already tilling the land, many of whom obtained the land *de facto* following Partition in 1947. Thus, one could presume the effects were purely favorable.

This is an *incremental* measure of surplus, and it can be argued that even the 1951 worker per acre ratio reflected a substantial amount of surplus. Mathur, for example [18, p. 187], cites earlier studies suggesting that in 1951 disguised unemployment in neighboring West Bengal might have been as high as 33 percent of the agricultural labor force. Much of this, however, was seasonal in nature, and this seasonal element would presumably remain constant and not affect our measure of labor surplus. The remaining disguised unemployment in 1951 presumably took the form of a less than full employment average work-week, measured in hours worked per worker. Our interpretation of the 1951 and 1961 shifts suggest that this type of disguised unemployment grew markedly during the period and that the 20 percent surplus of workers who entered the work force were largely absorbed by work-sharing.

Summary and Implications

Our analysis suggests that from a rather static, long-run kind of equilibrium in factor proportions in 1951, the effect of labor force growth in East Pakistan between 1951 and 1961 was to introduce a surplus of workers amounting to as much as 20 percent of the 1961 labor force. This surplus was "hidden" by a rearrangement of hours worked in agriculture that provided an opportunity for each member of the work force to produce at least enough for his subsistence. This surplus was in addition to whatever surplus existed in 1951 before the impact of population growth was felt.

Our data also suggest that the increases in total output that occurred between 1951 and 1961 in East Pakistan were the result of small increases in the cropped acreage as well as in the yield per acre, the latter chiefly being a reflection of greater intensity of cultivation.

It must also be noted that this analysis and these conclusions refer strictly to the period 1951–1961. The striking changes that occurred in the Second Five-Year Plan period (1960–1965) are no part of our story [6].

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The Effect of Technology on the Farm Labor Market*

LARRY L. BAUER

The primary purpose of this paper was to estimate the time path of the effect of technology, as measured by research and extension expenditures, on the farm labor market. A distributed lag function was estimated by incorporating the concept of rational distributed lag functions, as developed by Dale Jorgenson, into a simultaneous equation model of the farm labor market. The estimated lag distribution, even though quite long, had a "hump" as hypothesized. The implicit production function implied a positive payoff to the economy from research and extension expenditures.

THE PRIMARY purpose of this study was to investigate the time path of the effect of technology on the farm labor market; that is, a distributed lag function relating the effect of a change in technology to time was estimated. A lag function yields a set of weights, each of which shows the portion of total effect that occurs within a given time period. Since the total effect is to be distributed through time, the weights by necessity must add to one.

To date there is little behavioral theory to aid in estimating a lag distribution. Therefore, as in other studies, the lag distribution in this study was estimated by imposing a family of general distributions on the data and determining the one that in some sense "best" fit the data.

This study was based principally on papers by Wallace and Hoover [10] and Gisser [3]. However, whereas they used cross-sectional data, this study used both cross-sectional and time-series data.

Distributed Lags

The concept of rational distributed lag functions, as developed by Jorgenson [8], was used to estimate the lag distribution. This technique, unlike most other methods of estimation, does not restrict the lag distribution to a particular pre-specified configuration; it allows the data itself to determine the configuration of the lag distribution by estimating parameters of the general lag function concurrently with the parameters of the basic model.

An article by Griliches [6], which surveys various techniques that have been used to estimate lag functions, contains a summary of the concept of

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rational distributed lag functions that may be easier for the practical researcher to follow.

The Structural Model

The model consisted of two structural equations:

(1) Demand for farm labor:

$$Q_{it} = f(W_{it}, S_{it}, E_{it}, R_{it})$$

(2) Supply of farm labor:

$$W_{it} = g(Q_{it}, \overline{W}_{it}, U_{it})$$

where

Q_{it} = quantity of farm labor = total man hours of farm labor, including operator, family, and hired labor;
W_{it} farm wage rates = wage rate per hour for hired farm labor, in 1957–1959 dollars;
R_{it} = technology = state and federal expenditures for experiment station research and the cooperative extension service;
S_{it} = stock of land = stock of land excluding effects of farm programs, measured in 1957–1959 dollars;
E_{it} = other expenditures = current operating expenses, excluding expenditures for hired farm labor, measured in 1957–1959 dollars;
$\overline{W}_{it}$ = alternative wage rate = hourly wage rate for workers on manufacturing payrolls; measured in 1957–1959 dollars;
U_{it} = rate of unemployment = insured unemployment as a percent of average covered employment; and

where the subscripts

$i = 1 \ldots 39$ for 39 states or groups of states, and
t = time, for the years 1951 . . . 1961.

Two variables considered by Wallace and Hoover were not considered here, namely age and education, because no adequate measure for these variables exists for intercensal years.

Data for more than eleven years would have been desirable, but adequate data do not exist prior to 1949 and the 1964 Census of Agriculture data were not yet available at the time of this study. However, the assumption was made that each state has the same lag distribution, thus allowing the estimation of a lag distribution with data from so few years.

The variables Q_{it} and W_{it} were treated as endogenous and the rest were assumed to be exogenous, or predetermined. The equations were assumed to be additive, with the variables in logarithms. Mathematically stated, the structural model is:

Demand: $Q_{it}=\beta_0+\beta_1 W_{it}+\beta_2 S_{it}+\beta_3 E_{it}+A(L)\,\beta_4 R_{it}$
Supply: $W_{it}=\delta_0+\delta_1 Q_{it}+\delta_2 \overline{W}_{it}+\delta_3 U_{it}$

where all the variables are in logs and $A(L)$ is a lag polynomial in the rational form $N(L)/D(L)$ and L is the so-called lag operator.

To the extent that agriculture in a single state is competitive with other states, it is reasonable to take product demand as perfectly elastic in an analysis of cross-section data [3, 10]. When time series variation is introduced into the analysis, as in the present paper, the assumption of exogeneity of product price is less tenable. A formal attempt to minimize the chance for simultaneous equation bias would have required specifying additional equations for demand and supply in the agricultural product as well as the farm labor market, thus conditioning the subsequent reduced form estimation. However, it was decided that the increased complexity of additional equations was less desirable than the risk of simultaneous equation bias.

Reduced Form Equations

In order to estimate the parameters of the structural equations, two reduced form equations had to be estimated first, as follows:

$$Q_{it} = \Pi_{10} + \Pi_{11}S_{it} + \Pi_{12}E_{it} + A(L)\Pi_{13}R_{it} + \Pi_{14}\overline{W}_{it} + \Pi_{15}U_{it}$$

$$W_{it} = \Pi_{20} + \Pi_{21}S_{it} + \Pi_{22}E_{it} + A(L)\Pi_{23}R_{it} + \Pi_{24}\overline{W}_{it} + \Pi_{25}U_{it}$$

It should be noted that the rational lag function, $A(L)$, relating technology to the endogenous variable in the structure, remains invariant in the reduced form and appears as the coefficient of R_{it} in both equations.

Distributed Lag Function

As mentioned, there is little behavioral theory available to restrict the potential family of acceptable lag distributions. Therefore, the problem was one of finding the lag function yielding the set of weights that in some sense best fits the data. Three criteria suggested themselves in determining an acceptable distribution: (1) The coefficient of determination or R^2 for the estimated reduced form equation. This was an obvious choice since estimates that explain a large portion of variation in data are desirable. (2) Reasonableness of the estimated lag distributions, since some sets of estimates of the lag parameters can give negative weights, or weights that have no finite sum.[1] (3) The signs and magnitudes of the structural parameter estimates. An idea of magnitudes of the estimates was obtained from studies using either cross-sectional or time-series data [10, 9].

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[1] When the demand for farm labor is viewed as a value of marginal product relationship, it can be shown that the lag distribution $A(L)$ also applies to the technology variable in its effect on agricultural output in the production function. Thus, if the weights of the lag distribution have no finite sum, this would imply an infinite rate of return to a dollar spent on technology. Hence, such a lag distribution was ruled as implausible.

A "family" of five second-order rational lag functions, $P(L) = N(L)/D(L)$ were investigated (Table 1).[2] Since function 5 contains the largest number of lag parameters, it was used to develop a general mathematical statement that serves for all five functions. This is presented in the Appendix. With function 5 imposed on the data and after the mathematical manipulations are carried out, each reduced form equation contains 17 variables and a constant term. The coefficients are combinations of the reduced form parameters, the Π's; and the lag distribution parameters *a*, *b*, *c*, and *d*.

Table 1. Family of second-order lag functions

Function	$N(L)$	$D(L)$
1	1	$1-cL-dL^2$
2	$1+aL$	$1-cL-dL^2$
3	$1+aL+bL^2$	1
4	$1+aL+bL^2$	$1-cL$
5	$1+aL+bL^2$	$1-cL-dL^2$

Restricted Estimation

Estimation of the reduced form equations involved estimating ten reduced form parameters, two constant terms, and up to four lag distribution parameters, depending on which lag function was imposed on the data. A restriction implicit in the model was that the lag distribution parameters be the same in both equations. To do this, the equations were combined and estimated at the same time in one large regression. This was done by the following technique. Consider the two equations:

$$\begin{aligned} Y_{1t} &= \alpha Z_{1t} + \beta Z_{2t} \\ Y_{2t} &= \alpha Z_{3t} + \gamma Z_{4t} \end{aligned}$$

It is implicit that the estimate for α be the same in both equations. In order to accomplish the estimation subject to this restriction, the equations are combined as follows:

$$\begin{array}{ccc} Y & & \begin{array}{ccc} X_1 & X_2 & X_3 \end{array} & B \\ \begin{bmatrix} Y_{1t} \\ \\ Y_{2t} \end{bmatrix} & = & \begin{bmatrix} Z_{1t} & Z_{2t} & 0 \\ & & \\ Z_{3t} & 0 & Z_{4t} \end{bmatrix} & \begin{bmatrix} \alpha \\ \beta \\ \gamma \end{bmatrix} \end{array}$$

The vectors of data for the two dependent variables are combined into one

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[2] The polynomial $P(L)$ is an intermediate step in the derivation of the desired polynomial $A(L)$.

"long" vector, Y. The vectors of data for Z_1 and Z_3 also are combined into a "long" vector, X_1. However, the vector of data for Z_2 is regressed only on Y_1 and the data for Z_4 is regressed only on Y_2. The equation to be estimated is, in matrix notation,

$$Y = XB$$

where the matrix X is made up of the vectors X_1, X_2, and X_3. This equation can be estimated by least squares and will give one estimate of α, and unique estimates of β and γ subject to the restriction that α has the same value in both equations.

Thus, the combined equation estimated in this study is, in matrix notation,

$$Y = XB$$

where

$$Y = \begin{bmatrix} Q_{it} \\ W_{it} \end{bmatrix}$$

and the matrix X is made up of the vectors X_1, X_2, $\cdots X_{34}$, which are shown in Table 2. The matrix B is the vector of parameters to be estimated.

The dimensions of these matrices are:

$$\begin{aligned} Y &= 858 \times 1 \\ X &= 858 \times 34 \\ B &= 34 \times 1 \end{aligned}$$

The equation to be estimated was:

$$\begin{aligned} Y = {} & \Pi_{10}X_1 + \Pi_{20}X_2 + cX_3 + dX_4 + \Pi_{11}X_5 + \Pi_{21}X_6 - c\Pi_{11}X_7 - c\Pi_{21}X_8 \\ & - d\Pi_{11}X_9 - d\Pi_{21}X_{10} + \Pi_{12}X_{11} + \Pi_{22}X_{12} - c\Pi_{12}X_{13} - c\Pi_{22}X_{14} \\ & - d\Pi_{12}X_{15} - d\Pi_{22}X_{16} + \Pi_{13}X_{17} + \Pi_{23}X_{18} + a\Pi_{13}X_{19} + a\Pi_{23}X_{20} \\ & + b\Pi_{13}X_{21} + b\Pi_{23}X_{22} + \Pi_{14}X_{23} + \Pi_{24}X_{24} - c\Pi_{14}X_{25} - c\Pi_{24}X_{26} \\ & - d\Pi_{14}X_{27} - d\Pi_{24}X_{28} + \Pi_{15}X_{29} + \Pi_{25}X_{30} - c\Pi_{15}X_{31} - c\Pi_{25}X_{32} \\ & - d\Pi_{15}X_{33} - d\Pi_{25}X_{34} \end{aligned}$$

This was a regression with 858 observations and 34 variables. Since there were sixteen parameters to be estimated in this most general case, the estimation equation was overidentified, as was the case when the other four lag functions were imposed on the data.

Estimation of the Reduced Form Parameters

The equation is nonlinear with respect to the parameters. A technique of nonlinear estimation exposited by Clark Edwards [1] was used to get individual estimates of each of the parameters.

Table 2. The vectors, X_1, in the matrix X

Vector number	Vector	Vector number	Vector	Vector number	Vector
1	$\begin{pmatrix}1\\0\end{pmatrix}$	13	$\begin{pmatrix}E_{i,t-1}\\0\end{pmatrix}$	25	$\begin{pmatrix}\overline{W}_{i,t-1}\\0\end{pmatrix}$
2	$\begin{pmatrix}0\\1\end{pmatrix}$	14	$\begin{pmatrix}0\\E_{i,t-1}\end{pmatrix}$	26	$\begin{pmatrix}0\\\overline{W}_{i,t-1}\end{pmatrix}$
3	$\begin{pmatrix}Q_{i,t-1}\\W_{i,t-1}\end{pmatrix}$	15	$\begin{pmatrix}E_{i,t-2}\\0\end{pmatrix}$	27	$\begin{pmatrix}\overline{W}_{i,t-2}\\0\end{pmatrix}$
4	$\begin{pmatrix}Q_{i,t-2}\\W_{i,t-2}\end{pmatrix}$	16	$\begin{pmatrix}0\\E_{i,t-2}\end{pmatrix}$	28	$\begin{pmatrix}0\\\overline{W}_{i,t-2}\end{pmatrix}$
5	$\begin{pmatrix}S_{it}\\0\end{pmatrix}$	17	$\begin{pmatrix}R_{it}\\0\end{pmatrix}$	29	$\begin{pmatrix}U_{it}\\0\end{pmatrix}$
6	$\begin{pmatrix}0\\S_{it}\end{pmatrix}$	18	$\begin{pmatrix}0\\R_{it}\end{pmatrix}$	30	$\begin{pmatrix}0\\U_{it}\end{pmatrix}$
7	$\begin{pmatrix}S_{i,t-1}\\0\end{pmatrix}$	19	$\begin{pmatrix}R_{i,t-1}\\0\end{pmatrix}$	31	$\begin{pmatrix}U_{i,t-1}\\0\end{pmatrix}$
8	$\begin{pmatrix}0\\S_{i,t-1}\end{pmatrix}$	20	$\begin{pmatrix}0\\R_{i,t-1}\end{pmatrix}$	32	$\begin{pmatrix}0\\U_{i,t-1}\end{pmatrix}$
9	$\begin{pmatrix}S_{i,t-2}\\0\end{pmatrix}$	21	$\begin{pmatrix}R_{i,t-2}\\0\end{pmatrix}$	33	$\begin{pmatrix}U_{i,t-2}\\0\end{pmatrix}$
10	$\begin{pmatrix}0\\S_{i,t-2}\end{pmatrix}$	22	$\begin{pmatrix}0\\R_{i,t-2}\end{pmatrix}$	34	$\begin{pmatrix}0\\U_{i,t-2}\end{pmatrix}$
11	$\begin{pmatrix}E_{it}\\0\end{pmatrix}$	23	$\begin{pmatrix}\overline{W}_{it}\\0\end{pmatrix}$		
12	$\begin{pmatrix}0\\E_{it}\end{pmatrix}$	24	$\begin{pmatrix}0\\\overline{W}_{it}\end{pmatrix}$		

Weights of the Lag Distribution

The techniques discussed allowed unique estimates to be obtained for all the reduced form equation parameters and the lag distribution parameters. Given the parameters of the chosen lag distribution, the series of weights relating the effects of a change in technology through time could then be derived. This was done by carrying out the implicit division in $P(L)=N(L)/D(L)$, which yields a polynomial in the lag operator L, generally,

$$p_0 + p_1L + p_2L^2 + \cdots + p_tL^t$$

These p_i's are an approximation of the desired weights, since a restriction placed on the desired polynomial was that it sum to one. The series will not necessarily sum to one, and in all probability, it will not. However, it can be made to do so by dividing each element in the series by $\sum_{t=0}^{\infty} p_t$. Therefore, the weights desired, or coefficients of the polynomial A(L) are:

$$\frac{p_0}{\Sigma p_t} + \frac{p_1}{\Sigma p_t} + \cdots = w_0 + w_1 + w_2 + \cdots = 1$$

Griliches [6, p. 23] derives the weights in a slightly different manner, but the results are the same.

Estimation of the Structural Parameters

Since one of the criteria for selection of a lag distribution was the reasonability of the associated estimates of the structural parameters, a method which used only 1959 data was used to estimate the structural parameters in order that they might be compared with the estimates of similar coefficients in the Wallace-Hoover [10] study.

The first step was the computation of a new technology variable, R_{it}^*, which was essentially a weighted average of the data for the original R_{it} variable for 1959 and the 18 previous years, with the weights for calculating the average being the yearly weights from each of the five lag functions. In other words, the five estimated lag distributions were imposed on the technology variable.

From this point estimation was the same as in the Wallace-Hoover study, with one difference. The latter used an arbitrary lag function[3] to weigh the effect of previous research and extension expenditures, whereas this study used as weights those yearly weights generated by the five lag functions, each estimated by combining cross-section with time-series data. A set of estimates for the structural parameters was obtained for each of the five lag functions. Since the system of structural equations was overidentified, a technique similar to two-stage least-squares[4] was necessary.

Specifically, the estimation procedure was to use first the estimates of Π_{11}, Π_{12}, Π_{13}, Π_{14}, Π_{15}, a, b, c, and d to get predicted values of Q_{it}, and then the estimates Π_{21}, Π_{22}, Π_{23}, Π_{24}, Π_{25}, a, b, c, and d to get predicted values of W_{it}. The estimates of the structural parameters for the supply equation were then obtained from the regression of

$$W_{it} \text{ on } \hat{Q}_{it},\ \overline{W}_{it},\ U_{it}$$

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[3] Wallace and Hoover [10] used a five year geometric mean of research and extension expenditure data.

[4] This is a technique discussed in econometrics textbooks, *e.g.*, Johnston [7].

and the estimates of the structural parameters in the demand equation were obtained from the regression of

$$Q_{it} \text{ on } \hat{W}_{it}, S_{it}, E_{it}, R_{it}^*$$

where

$$t = 1959$$

$$R_{it}^* = A(L)R_{it}$$

and the "hats" indicate predicted values.[5]

The Estimated Lag Distribution

Estimation was carried out according to the procedures described. The lag function was selected on the basis of the three criteria established, with the result that functions 4 and 5, which were of very similar configuration, were chosen. Function 3 was eliminated because it had the lowest R^2 of the five functions, as well as negative weights in the lag distribution. The R^2's of the other four functions were not significantly different, and all had reasonable lag distributions. Functions 4 and 5 were chosen on the basis of the reasonability of the estimates of the structural parameters. Functions 1 and 2 were eliminated because they implied negative supply elasticities.

The estimated lag functions were, in the case of function 4:

$$P(L) = \frac{1 + 3.169L - 3.867L^2}{1 - .985L}$$

and in the case of function 5:

$$P(L) = \frac{1 + 2.970L - 3.698L^2}{1 - 1.061L + .075L^2}$$

It should be recalled that each of these polynomials must be divided by its respective sum in order to generate the desired weights; that is,

$$A(L) = \frac{P(L)}{\Sigma p_t}$$

The mean of function 4 is 49.2 years and the mean of function 5 is 45.1 years.[6] The median of function 4 is approximately 27 years; for function 5, approximately 22 years. These two distributions are shown graphically in Figure 1, and the weights for several years are presented in Table 3.

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[5] Regression was done both ways, *i.e.*, Q was regressed on $\hat{W}$ and then W on $\hat{Q}$ for both demand and supply. The two sets of estimates for the demand relationship were very similar, but some differences did exist in the estimates of the supply relationship.

[6] See Griliches [6, p. 18] for procedure used in finding means of distributed lag functions.

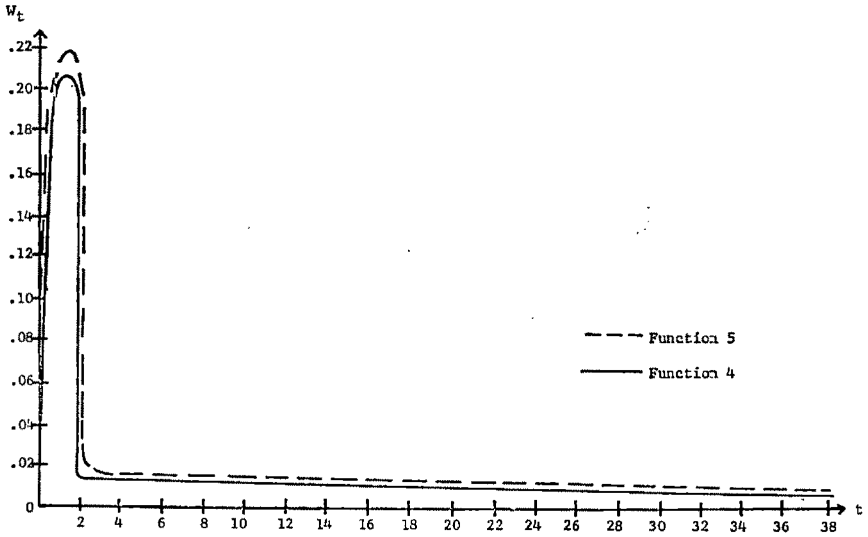

Figure 1. Configuration of the estimated lag distribution

As hypothesized, the estimated lag distribution has a "hump," that is, the greatest effect within any given time period occurs after the passage of time rather than in the initial period as would be the case had a Koyck or monotonically declining function been imposed on the data. This conforms with findings of other studies, such as Griliches [4] and Evenson [2], and would seem to be a reasonable phenomenon. The results here indicate that the largest effect occurs in the second time period, in which an excess of 20 percent of the total effect takes place. The weights of the distribution then decline to a point where there is very little change from one period to the next.

The estimated lag distribution is quite long which, intuitively, seems somewhat unrealistic. However, when this is weighed against the positive characteristics—the distribution has a hump, the sum of the weights is finite, and the weights are all positive—the overall results seem favorable. A possible explanation of the length is that the estimated distribution is a convolution, or combination, or more than one lag distribution. At a minimum, it would seem that the estimated distribution could be considered as a convolution of the lag between the funding of research and its subsequent conclusion and the lag between conclusion of the research and the time it is put into practice. In addition, the technology variable used here considers not only funds for research but funds for extension activities as well; therefore, the estimated lag distribution could also be considered to contain the convolution of the separate lag distributions for research and extension. These convolutions would seem to tend to lengthen the lag distribution.

Table 3. The numerical weights, w_t, of the estimated lag distributions

Time period t	Function 4	Function 5
0	.05055	.05446
1	.20999	.21950
2	.01131	.02770
3	.01114	.01281
4	.01097	.01150
5	.01080	.01123
6	.01063	.01104
7	.01047	.01086
8	.01031	.01069
9	.01015	.01052
10	.00999	.01035
11	.00984	.01018
12	.00969	.01002
13	.00954	.00986
14	.00939	.00970
15	.00925	.00954
16	.00911	.00939
17	.00897	.00924
18	.00883	.00909
19	.00869	.00894
20	.00856	.00880
21	.00843	.00866
22	.00830	.00852
23	.00817	.00838
24	.00804	.00825
25	.00792	.00812
26	.00780	.00799
27	.00768	.00786
28	.00756	.00773
29	.00744	.00761
30	.00733	.00749
31	.00722	.00737
32	.00711	.00725
33	.00700	.00713
34	.00689	.00702
35	.00678	.00691
36	.00668	.00680
37	.00658	.00669

Another reason for the long distribution is likely to be the assumption made in this study that a common lag distribution existed for all states. In reality, in all probability, there are pronounced differences in the lag distribution for each individual state. This may be due to differences in the production periods associated with the important farm products of different states, for example, it would take longer for the results of particular research to become apparent in a state that has primarily a woodland agriculture than in a state that produced primarily small grain.

Some of the considerations discussed here are illustrated in the study by Griliches [4] on hybrid corn. He considered one particular area of research and did not consider extension activities. However, since both his work and this study consider research activities as a measure of technical change, some comparison can be made. In the first place, the Griliches study emphasizes the likelihood that a common lag distribution does not hold for all states. He showed that each state accepted hybrid corn at a different rate and that twelve years elapsed between when the earliest and the latest state had 10 percent of their total corn acreage in hybrid corn.

The Griliches study also exemplifies the fact that the distribution estimated in this study is a convolution of more than one distribution. He dealt with two lag distributions: the lag between the availability of hybrid corn and its use by farmers, and the lag between states in the use of hybrid corn.

In the Griliches study, the median lag of the acceptance of hybrid corn within a particular state ranged from five to ten years. The median lags for the two distributions estimated in this study were 22 and 27 years. These medians would seem rather comparable inasmuch as the distribution estimated in this study was a convolution of several distributions, included all research expenditures as well as extension, and assumed a common distribution for all states.

As mentioned, the lag functions (or, in actuality, logistic growth curves) estimated by Griliches implied that a "hump" existed in the distribution; that is, the maximum effect occurred sometime after the initial time period.

Evenson [2] considered distributions of two shapes—monotonically declining and an inverted "V". He found the inverted "V" best fit the data. This is consistent with the "humped" distributions estimated in this study and by Griliches. However, the mean lag in the Evenson study was six to seven years in comparison with the 45 to 50 year mean of the distribution estimated in this study.

Structural Parameters

The estimates of the structural parameters are given in the following equations:

$$\text{Demand: } Q_{it} = -.864 - 1.482\hat{W}_{it} + .221S_{it} + .476E_{it} + .317R_{it}^{*}$$

$$\text{Supply: } W_{it} = -1.043 + .0005\hat{Q}_{it} + 1.199\overline{W}_{it} - .049U_{it}$$

Standard errors are not reported since the standard errors from the two-stage least-squares estimation presented difficult problems of interpretation.[7]

The estimates of the coefficients of the demand equation are fairly comparable with those from the Wallace-Hoover [10] study. The signs are all consistent with what one would have expected. The inference from the estimation equation for demand is that, assuming a perfectly elastic supply of labor and a perfectly elastic demand for farm output, a 10 percent increase in technology, that is, a 10 percent increase in research and extension expenditure, will lead to a 3.2 percent increase in the quantity of farm labor demanded. Alternatively, the implication is that a 10 percent increase in technology will lead to a 2.1 percent increase in the farm wage rate if the quantity of farm labor is held constant. These are the total, or long run, effects of a change in technology. The lag distribution gives the portion of the total effect that occurs within any given year.

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[7] The technique used was only similar to two-stage least-squares. The estimation of the reduced form and the lag distribution parameters, used to calculate R_{it}^{*}, $\hat{W}_{it}$, and $\hat{Q}_{it}$, used both the cross-sectional and time-series data, whereas the structural parameters were estimated using only 1959 data. This presented an interpretation problem with respect to the standard errors calculated in the two-stage least-squares estimation of the structural parameters. For those who may wish to make interpretations, all the structural parameter estimates, with the exception of the coefficients of $\hat{Q}_{it}$ and U_{it} in the supply equation, were significant at least at the 95% level when the calculated standard errors were considered.

The signs of the estimates of the coefficients in the supply equation are all consistent with what one would have expected. The estimate of the coefficient for the quantity of farm labor variable is much smaller than the comparable coefficient from the Wallace-Hoover study.

Adjustment for the Product Market

The estimate of the technology parameter implies that an increase in research and extension expenditures has a positive effect on gross return to farm labor since it has a positive effect on the quantity of labor demanded. However, this estimate was made given the assumption of perfect elasticity of product demand. Estimation was carried out on the premise that the simultaneous equation bias would not be too great by treating product prices as exogenous. However, in making inference from the estimates, one need not continue the premise of exogeneity of product prices.

A technique used by Gisser [3, p. 590] and Wallace and Hoover [10, p. 330] was used to adjust the research and extension coefficient for different product demand elasticities. This technique is based on the assumption that the demand relationship estimated is the value of marginal product for labor. From this a production function can be determined. By assuming a particular form for the product demand relationship, stating the demand for labor as generally being marginal physical product times product price, doing the appropriate substitution, and finding $\partial Q_{it}/\partial R_{it}^*$, the desired adjustment factor is obtained. It is

$$b_4^* = b_4 \frac{(\epsilon + 1)}{(\epsilon + 1 + b_1)}$$

where

b_4 = original estimate of research and extension coefficient,
b_4^* = research and extension coefficient adjusted for different product demand elasticities,
ϵ = assumed product demand elasticity, and
b_1 = coefficient of $\hat{W}_{it}$ in labor demand relationship.

Table 4 gives values of the coefficient adjusted for various elasticities. The technology coefficient becomes negative when the value of the elasticity coefficient becomes less than one in absolute value, that is, when the product

Table 4. Coefficient of technology variable for alternative product demand elasticities

Product demand elasticity	Coefficient of technology variable
0	−.658
− .10	−.490
− .25	−.325
− .50	−.161
− .75	−.064
−1.00	0
−1.25	.046
−1.50	.080
−1.75	.107
− ∞	.317

demand becomes inelastic. For example, with an inelastic product demand of −.10, a 10 percent increase in technology would decrease the quantity of labor demanded by 4.9 percent. The implication is that by relaxing the assumption of infinite product demand and considering inelastic demand relationships for farm production, the increase in technology has a negative effect on farm income. This is so because the increase in technology increases total farm output, and this, given a very inelastic product demand relationship, depresses farm prices; hence, the value of marginal product or demand for labor also declines, causing a decline in personal farm income with a given labor supply relationship.

The Implicit Production Function

An intermediate step in the development of an adjustment for alternative product demand elasticities was that of deriving the implicit production function from the labor demand relationship. The production function for the coefficient estimates obtained in this study is

$$Y_{it} = .325Q_{it} + .149S_{it} + .322E_{it} + .214R_{it}^*$$

where Y_{it} = total farm output, the constant term is omitted, and all variables are in logarithms. This is a Cobb-Douglas type exponential production function and the sum of the coefficients is 1.01, implying essentially constant returns to scale. An implication of this production function, similar to a result by Griliches [5], is that there is a positive payoff to the economy from research and extension expenditures; in other words, the coefficient of R_{it}^* is positive. An extension of this paper will be to determine the internal social rate of return to research and extension expenditures using the estimated lag distributions and various product demand assumptions.

Appendix

Taking the most general lag function, number 5:

$$P(L) = \frac{N(L)}{D(L)} = \frac{1 + aL + bL^2}{1 - cL - dL^2}$$

and imposing it on the research and extension variable, R_{it}, the result in the reduced form equations is

$$Q_{it} = \Pi_{10} + \Pi_{11}S_{it} + \Pi_{12}E_{it} + \Pi_{13}\frac{1 + aL + bL^2}{1 - cL - dL^2}R_{it} + \Pi_{14}\overline{W}_{it} + \Pi_{15}U_{it}$$

$$W_{it} = \Pi_{20} + \Pi_{21}S_{it} + \Pi_{22}E_{it} + \Pi_{23}\frac{1 + aL + bL^2}{1 - cL - dL^2}R_{it} + \Pi_{24}\overline{W}_{it} + \Pi_{25}U_{it}$$

After the implicit multiplication is carried out and the variables lagged according to the lag operators, the results are:

$$\begin{aligned}
Q_{it} = {} & \Pi_{10} + cQ_{i,t-1} + dQ_{i,t-2} + \Pi_{11}S_{it} - c\Pi_{11}S_{i,t-1} - d\Pi_{11}S_{i,t-2} \\
& + \Pi_{12}E_{it} - c\Pi_{12}E_{i,t-1} - d\Pi_{12}E_{i,t-2} + \Pi_{13}R_{it} + a\Pi_{13}R_{i,t-1} \\
& + b\Pi_{13}R_{i,t-2} \\
& + \Pi_{14}\overline{W}_{it} - c\Pi_{14}\overline{W}_{i,t-1} - d\Pi_{14}\overline{W}_{i,t-2} + \Pi_{15}U_{it} \\
& - c\Pi_{15}U_{i,t-1} - d\Pi_{15}U_{i,t-2} \\
W_{it} = {} & \Pi_{20} + cW_{i,t-1} + dW_{i,t-2} + \Pi_{21}S_{it} - c\Pi_{21}S_{i,t-1} - d\Pi_{21}S_{i,t-2} \\
& + \Pi_{22}E_{it} - c\Pi_{22}E_{i,t-1} - d\Pi_{22}E_{i,t-2} + \Pi_{23}R_{it} + a\Pi_{23}R_{i,t-1} \\
& + b\Pi_{23}R_{i,t-2} \\
& + \Pi_{24}\overline{W}_{it} - c\Pi_{24}\overline{W}_{i,t-1} - d\Pi_{24}\overline{W}_{i,t-2} + \Pi_{25}U_{it} - c\Pi_{25}U_{i,t-1} \\
& - d\Pi_{25}U_{i,t-2}
\end{aligned}$$

These equations can be made into those appropriate for function 2, for example, by setting the parameter b equal to zero.

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Mergers and Diversified Growth of Large Grain Firms*

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Firm growth by merger has received considerable attention because of its potential effects on industry organization and, in turn, economic performance. Early mergers often increased horizontal concentration, but recent ones appear to have been more associated with vertical and conglomerate integration. This study of 35 large firms in grain processing and merchandising industries showed that growth by merger was relatively larger from 1954 to 1963 than from 1940 to 1954. All but eight of the 35 firms became more highly diversified. Increasing diversification was associated positively with initial firm size and the relative importance of external growth.

LARGE business firms in the United States are becoming increasingly diversified,[1] and this trend is giving rise to new issues of antitrust policy. Diversification appears to have been associated, at least in part, with growth by merger or acquisition, sometimes called external growth.

In the past, merger movements, or periods of active external growth, have produced more dramatic changes in industrial organization than internal growth, which refers to capital invested in new plants and equipment [6]. This has occurred even though internal growth, while varying widely over time and among firms, has accounted for the larger portion of total growth.

Mergers early in this century were associated mainly with greater horizontal concentration [8], whereas those occurring later, especially acquisitions by large firms, appeared to be more related to increases in vertical and conglomerate integration. As a consequence, the particular effects of recent mergers may differ significantly from those of earlier periods, but it is likely that merger activity and public policy toward mergers will continue to have a pronounced effect on the rate and direction of structural change in American industry.

It is not known precisely how widespread diversification is among firms that process and distribute agricultural products, why it has come about, what the trends are, nor what the consequences may be. This study was undertaken to measure and analyze growth by merger of large firms active in a major sector of the agricultural economy—the processing and merchandising of grains and grain products. Particular emphasis was

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[1] For example, Gort found that 111 of the largest companies in the United States added 40 to 50 products a year from 1929 to 1950, but more than twice as many each year from 1950 to 1954 [5, p. 46].

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given to interrelations among firm size, external growth, and diversification.

Selection of Firms for Study

Thirty-five firms were selected for this study, based on their relative sizes in the North Central region in 1960.[2] Because most U.S. grain is produced in this region, these firms were also important nationally. Each accounted for five percent or more of regional volume in one or more of nine industry divisions (cereal, distilling, dry corn milling, feed manufacturing, flour milling, malting, merchandising, soybean processing, and wet corn milling). Two additional firms fell within this classification but were not included in the study because adequate size and growth data could not be obtained. These two firms accounted for 12 percent and five percent of their respective industries.

The firms studied did not, of course, occupy the same relative industry positions in 1960 that they had held in 1940, the beginning year of the study; they were the survivors who had either maintained or achieved dominance. Hence, it is likely that, as a group, they had grown faster and diversified somewhat more than average.

Size and Growth of 35 Large Grain Firms

Combined assets of the 35 firms rose from $1.4 billion in 1940 to $6.9 billion in 1963. About half of the increase represented real growth; the other half, inflation. Value of assets in real terms more than doubled during the period.

Direct external growth amounted to an estimated $1.257 billion between 1940 and 1963, or 22.7 percent of total growth. Relatively greater in the latter part of the period, it amounted to 28.8 percent of total growth between 1954 and 1963; 15.9 percent, between 1947 and 1954; and 18.3 percent, from 1940 to 1947.

Although numerous difficulties were encountered in measuring external growth precisely, the estimates are believed to be reasonably accurate for these firms.[3] However, the relative importance of external growth was probably somewhat understated for the following reasons: (1) Only direct external growth was measured. Growth that may have been generated from assets acquired earlier was classified as internal. (2) Price inflation of facilities acquired prior to the end of a period was also included as part of residual internal growth.[4] (3) Of the 641 acquisitions and 216 disposals recorded, the values of 120 acquisitions and 29 disposals could not be estimated. (4) Some transactions may have been overlooked. While possible overlooked disposals would partly compensate for missed acquisitions, the net effect of omissions would be toward underestimation of external growth. Taking these reasons into account, actual external growth may have approached one third of total growth, particularly in the latter part of the period.

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[2] This was part of a North Central regional research project in grain marketing (NCM-30) [1, 2]. Relative sizes were derived from a 1960 NCM-30 survey [4].

[3] Data were obtained from a variety of sources, including Moody's Industrial Manual, corporate annual reports, previous research studies, Federal Trade Commission merger listings, financial periodicals, and trade journals. Estimates were made for missing data where estimating criteria were considered reliable, and the firms were then asked to make corrections and additions.

Firm size in 1963, measured by value of assets, ranged from slightly over $6 million for the smallest firm to nearly $700 million for the largest. The five largest firms, each with assets valued at more than one-half billion dollars, accounted for 45 percent of the total assets of all 35 firms in 1963.

Increasing Diversification

All but eight firms became more highly diversified between 1940 and 1963. Six firms entered new major Bureau of the Census Standard Industrial Classifications or alpha code industries. Twenty firms entered new two-digit industries, 26 entered new three-digit industries, and 27 firms entered new four-digit industries. Four of these each added more than 15 new four-digit industries to their lines of business.

A firm diversification index, developed to facilitate summarization of diversification tendencies, rose from an average of 1.61 for all 35 firms in 1940 to 3.21 in 1963, a gain of 1.60 (Table 1). Among the three groups—specialized, intermediate, and diversified—the 10 most diversified firms in 1963 were more diversified than others in 1940 and had become increasingly diversified relative to the other groups during the 1940-63 period. Firms in this group also were generally larger than firms in other groups. Thirteen firms remained highly specialized throughout the period.

Increasing diversification between 1940 and 1963 was associated with growth by merger or acquisition. An estimated 71 percent of external growth was considered either vertical or conglomerate rather than horizontal. Vertical growth backward toward sources of supply amounted to six percent; vertical growth forward, 17 percent. Conglomerate growth in areas unrelated to a firm's previous activities was estimated at 12 percent; in industries other than grain but somewhat related to a firm's previous nongrain activities, 34 percent; and in grain but unrelated to a firm's previous grain activities, 2 percent.

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[4] An estimate based on constant value dollars indicated that 26.5 percent of asset growth between 1940 and 1963 was external, compared with 22.7 percent reported above. The external growth ratio in constant dollars was computed by multiplying the yearly ratio of external growth to total growth in current dollars for the 35 firms by the yearly change in constant dollar assets of these firms.

Table 1. **Diversification of 35 large grain firms, 1940 and 1963, grouped by degree of diversification in 1963**[a]

Degree of diversification	Number of firms	1940	1963	Change 1940–63
		average diversification index[b]		
Specialized	13	1.10	1.32	+ .22
Intermediate	12	1.57	2.99	+1.42
Diversified	10	2.33	5.93	+3.60
All firms	35	1.61	3.21	+1.60

[a] Major sources of empirical data were company annual reports, *Moody's Industrial Manual* for appropriate years, and the "1963–64 Plant and Product Directory" published by *Fortune.*

[b] The diversification index for each firm is the geometric mean of the number of U. S. Bureau of the Census, SIC, industries, one through four digits, in which the firm was engaged. For illustration, a hypothetical firm that processes soybeans (2092), produces livestock (0139), slaughters livestock (2011), processes meat (2013), tans leather (3111), and operates a meat market (5422) has a diversification index of 4.36 ($\sqrt[4]{3\cdot 4\cdot 5\cdot 6}$). This firm is in three SIC divisions (livestock production is in A; soybean processing, livestock slaughtering, meat processing, and leather tanning, in D; and meat retailing, in F). It is in four major groups (soybean processing, livestock slaughtering, and meat processing are in Major Group 20: Food and kindred products; livestock production, in Major Group 01; Commercial farms; leather tanning, in Major Group 31: Leather and leather products; and meat retailing, in Major Group 54: Retail trade). The firm operates in five three digit groups (livestock slaughtering and meat processing are in Meat Products Group 301; all others are in separate three digit groups). It is in six four-digit industries.

The geometric mean, in contrast with the simple average, was believed appropriate in reflecting the degree of diversification in a firm. Although its value is always smaller than the simple average, the geometric mean is relatively larger with more diverse activities, which are represented by the numbers on the left under the square root sign in the above example. The index treats both vertical and conglomerate integration as diversification.

Interrelations Among Size, Growth, and Diversification

Growth characteristics of the 35 firms for the 1954-63 period are shown in greater detail in Table 2. The more important associations were as follows:

(1) Overall rate of growth and percent of external growth were both inversely related to 1954 size.
(2) The larger firms were the more diversified.
(3) The most diversified firms grew most slowly between 1954 and 1963.
(4) Over one-third of the 1954-63 growth of the eleven most diversified firms in 1954 consisted of acquired facilities.
(5) Ten firms with the greatest increase in diversification between 1954 and 1963 were more diversified than other firms in 1954 and also averaged about three times as large.

Additional cross classification, based on both the 1954-63 period and the 1940-63 period, generally indicated that increasing diversification was positively associated with initial size, initial degree of diversification, and

Table 2. Assets, growth, external growth and diversification, 35 large grain firms by selected firm classification, 1954–63

Firms classified by	Assets per firm in 1954	Growth in assets 1954–63	External growth 1954–63	Diversification in 1954	Change in diversification 1954–63
	million dollars	percent		index	
Size in 1954					
13 smallest	*14.6*	86.7	38.8	1.35	+ .29
11 intermediate	*86.0*	76.1	28.6	2.55	+ .51
11 largest	*285.1*	56.8	27.9	3.78	+1.21
Growth rate, 1954–63					
13 slowest	155.7	*30.5*	24.9	2.57	+ .49
11 intermediate	146.6	*66.1*	31.8	3.11	+ .88
11 fastest	57.7	*154.6*	27.9	1.87	+ .74
Percent external growth, 1954–63					
13 lowest	114.2	61.9	*7.1*	2.29	+ .42
11 intermediate	173.6	59.2	*28.6*	2.51	+1.19
11 highest	79.6	70.1	*61.5*	2.71	+ .60
Diversification in 1954					
13 specialized	28.1	88.7	23.8	*1.15*	+ .47
11 intermediate	117.2	81.0	23.7	*2.29*	+ .45
11 conglomerate	242.9	49.6	34.1	*4.29*	+1.28
Change in diversification, 1954–63					
14 least[a]	75.8	54.2	23.4	2.21	*− .03*
11 intermediate	70.5	71.2	36.4	2.25	*+ .45*
10 most	236.4	62.9	27.7	3.16	*+1.91*
All 35 firms	*122.0*	*62.4*	*28.8*	*2.49*	*+ .72*

[a] Includes 13 firms with no change in diversification between 1954 and 1963 and one firm with a decline.

external growth. A regression equation was estimated in order to determine the relative strength of these relationships, where

Y = Change in diversification index for each firm between 1940 and 1963,

X_1 = Dollar value of each firm's assets in 1940

X_2 = Diversification index for each firm in 1940, and

X_3 = Ratio of external growth to total growth for each firm during the 1940–63 period.

The results were as follows:

$$\begin{array}{l} Y = .167 + .011X_1^{*} + .131X_2 + .039X_3^{**} \\ \qquad\quad (.006) \qquad (.464) \qquad (.015) \end{array} \qquad R^2 = .31$$

(Standard errors in parentheses)

* Significant at 10 percent level

** Significant at 2 percent level

The results were consistent with tendencies observed earlier, but in this analysis the initial level of diversification was not strongly associated with further change in diversification. Similar associations were found for the 1954-63 period, although the ratio of explained to total variance was .24 rather than .31.

Conclusions and Implications

Growth by merger increased in relative importance for several large firms in the grain industry between 1940 and 1963. All but eight of the 35 firms studied became more highly diversified. Increasing diversification was associated positively with initial firm size and the relative importance of external growth. This tendency was consistent with the Federal Trade Commission's finding that large food manufacturing firms generally have turned increasingly to conglomerate mergers both within and outside the food industry, with a relative decline in horizontal mergers [7, p. 109].

The growing diversity within large firms seems likely to alter their behavior patterns and their competitive positions relative to other firms who deal or compete with them [3]. Just how the development eventually will influence overall economic performance and future industry structure is not altogether clear. Because of the size and pervasiveness of this structural change, further inquiry into causes and consequences of divesification tendencies may be increasingly useful both to business firms, in making management decisions, and to government agencies, in formulating and applying appropriate antitrust policies.

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Federal Milk Marketing Order Provisions: Effects on Producer Prices and Intermarket Price Relationships*

George W. Ladd

Federal milk marketing orders contain formulas that determine prices received by farmers for milk delivered to bottlers. Different orders contain various combinations of provisions. Cross-section data were used to test the hypothesis that order prices are related to the provisions contained in orders. The hypothesis was accepted. Some 78 percent of the variance in prices is explained by two economic variables: distance of order market from Eau Claire, Wisconsin, and class I utilization ratio. Inclusion of dummy variables to allow for effects of order provisions increased the proportion of explained variance to 94 percent. Covariance analysis found no significant changes between years in the effects of order provisions on prices. Many possible combinations of provisions are not used in any order. Many of these combinations would provide unacceptable prices if they were used.

IN RECENT years the problem of maintaining proper milk price relationships among federal order fluid milk markets has become increasingly serious. This is mainly due to three factors:

(a) increase in the size and number of orders,
(b) improvements in the highway system and developments in long-distance hauling of bulk and of packaged milk, and
(c) growth in size of grocery chain stores and bottling plants.

The Federal Milk Order Study Committee was concerned with problems of intermarket relationships [2, pp. II-2-1 to II-2-15, II-4-1 to II-4-56, III-19 to III-23]. In 1955 the Agricultural Marketing Service published a study which dealt, in part, with intermarket price relationships [8]. Later, Babb [1] analyzed intermarket price relationships.

The objective of my study was to test hypotheses concerning effects of federal order provisions on relationships among prices in federal order markets. Dummy variables were used to study effects of order provisions. Covariance analysis was used to test for variation in the effects of these provisions.

The hypotheses tested will be presented after a brief discussion of federal order provisions; more complete descriptions can be found in publications of the U.S. Department of Agriculture [9, 10].

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Federal Order Provisions

Most orders classify dairy products and milk into two classes. Fluid milk products—bottled or cartoned milk or cream, flavored milk drinks, etc.—are included in class I, and milk used in these products is class I milk. All other products are class II products; milk used in them is class II milk.

Minimum dealer prices for class II milk are determined by formulas based on prices of manufactured dairy products or on prices paid for milk used in such products. In some orders, minimum dealer prices for class I milk are determined by manufacturing milk formulas, which relate the class I price to prices of manufactured dairy products or the price of milk used in such products. In other orders, minimum dealer prices for class I milk are determined by economic formulas, which relate the class I price to selected economic factors such as prices and available supplies of feed, consumer income, and wholesale price index. In every order, the price for class I milk exceeds the price for class II milk.

Some orders contain a supply-demand adjuster provision. Under this provision the current class I utilization ratio (the proportion of milk received under the order used in class I products) is compared with a standard class I utilization ratio. If the current ratio is above the standard ratio, the minimum order price for class I milk is raised. If the current ratio is below the standard ratio, the minimum order price for class I milk is reduced.

Some orders contain a seasonal class I price differential provision, under which the minimum dealer price for class I milk varies seasonally.

After the minimum class prices to be paid by bottlers are established, the prices to farmers are computed. In an order having a market-wide pool, the total money value of all milk delivered to regulated bottlers by farmers is combined into one pool. The blend price is computed by dividing the value of this pool by the quantity of milk priced under the order. Each milk producer receives this blend price, minus his butterfat and location differential. In an individual-handler pool, a blend price is computed for each bottler separately. Each producer receives the blend price computed for his bottler minus butterfat and location differential.

Many orders contain one of two types of seasonal producer pricing provisions: the base-excess plan or the Louisville plan. Producer blend prices normally vary seasonally. These seasonal pricing provisions affect the seasonal variation in each producer's blend price.

Previous Studies

Babb [1] estimated equation (1) for each year 1947 through 1960.

$$Y_i = \beta_2 + \beta_3 X_{i3} + \beta_4 X_{i4} + \epsilon_i \tag{1}$$

where

Y_i = weighted average annual blend price, in dollars per cwt., for milk of 3.5 percent butterfat content in federal order market i.

$X_{i2} = 1$ for all federal order markets.

X_{i3} = distance of i-th federal order market from Eau Claire, Wisconsin, in miles.

X_{i4} = average annual class I utilization ratio in i-th federal order market. $0 \leq X_{i4} \leq 100$.

Since the order price for class II milk in Eau Claire, if Eau Claire had an order, would equal β_2, we expect β_2 to be positive. The area around Eau Claire is a potential source of grade A milk for any market. Since the cost of obtaining milk from the Eau Claire area increases with increasing distance from Eau Claire, we expect β_3 to be positive. Since class I price exceeds class II price, blend price rises as class I utilization ratio rises. Hence we expect β_4 to be positive. Babb's results agreed with expectations; he obtained positive significant values for b_2, b_3 and b_4 [1, p. 7]. (b_i represents the estimated value of β_i.) He found a positive correlation between b_2 and the level of support prices for dairy products and a negative correlation between b_3 and the level of support prices [1, pp. 2, 18]. He found that class I prices in northeastern markets were higher than predicted by (1), and he attributed this to the use of economic formulas in these markets [1, pp. 8–9]. Babb suggested [1, p. 7] that the type of pool affects blend price, but does so primarily by affecting class I utilization ratio. Many others have noted that markets with individual handler pools have higher class I utilization ratios and higher blend prices [8, p. 48; 5, pp. 4 and 7].

Williams et al. [11, pp. 40–43] noted that unlike behavior by supply-demand adjusters in different markets can affect intermarket price relationships. If these relationships are affected by differences in supply-demand adjusters, they may also be affected by the presence or absence of a supply-demand adjuster.

The Federal Milk Order Study Committee stated that the use of different seasonal pricing arrangements may cause short-run disparities in class I prices [2, pp. II-4-3]. This raises the question whether these seasonal pricing arrangements affect annual blend price relations. A finding that they do so would emphasize the importance of the question raised by Russell [7]. When he found that the seasonal pricing plan in the Boston federal order resulted in little variation in farmers' gross income from milk, even though seasonal production patterns varied substantially, he questioned the effectiveness of present seasonal pricing plans in stimulating more stable year-round production and proposed an alternative seasonal pricing plan.

These reports suggest that it will be useful to modify equation (1) to allow for effects of: (a) type of pool, (b) type of class I formula, (c) a supply-demand adjuster, (d) seasonal pricing plan, and (e) level of support prices for dairy products.

Procedure

Effect of federal order provisions

Variables X_{i5} through X_{i10} classify markets according to characteristics of their orders.

$X_{i5}=1$ if federal order in i-th market had a seasonal class I differential plan.
$=0$ otherwise
$X_{i6}=1$ if federal order in i-th market had a base-excess plan.
$=0$ otherwise
$X_{i7}=1$ if federal order in i-th market had a Louisville Plan.
$=0$ otherwise
$X_{i8}=1$ if federal order in i-th market had an individual handler pool.
$=0$ otherwise
$X_{i9}=1$ if federal order in i-th market contained an economic class I price formula
$=0$ otherwise
$X_{i10}=1$ if federal order in i-th market had a supply-demand adjuster.
$=0$ otherwise

Understanding the meaning of these variables is helped by referring to Table 1.[1] If the order in the i-th market contained a seasonal class I price differential, $X_{i5}=1$; if it contained an individual handler pool, $X_{i8}=1$; if it lacked a supply-demand adjuster, $X_{i10}=0$, etc. Class I orders contain a seasonal class I price differential, base-excess provisions, a market wide pool, a manufacturing milk class I price formula and a supply-demand adjuster. Orders in class II differ from these only in lacking a supply-demand adjuster. Each class of order represents a different combination of order provisions.

Let P_{i1} and P_{i2} represent class I and class II prices in the i-th market, and suppose they are related to the provisions in the federal order and to X_{i3}. Then we can write

$$P_{i1} = f_1(X_{i3}, X_{i5}, \cdots, X_{i10})$$
$$P_{i2} = f_2(X_{i3}, X_{i5}, \cdots, X_{i10})$$

and

$$(2) \qquad Y_i = [f_1X_{i4} + f_2(100 - X_{i4})]/100$$

Equation (2) will contain cross product terms of the form $X_{ij}X_{i4}$ if f_1 and f_2 are linear. Neither theory nor previous empirical work provides evidence as

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[1] During 1962 there were no orders of certain classes. These empty classes are excluded from Table 1.

Table 1. Federal order classes

Order class	Number of orders in class in 1962	Seasonal class I differential		Seasonal blend price plan			Pool		Class I formula		Supply-demand adjuster	
		Yes $X_5=1$	No $X_5=0$	Base-excess $X_6=1$ $X_7=0$	Louisville $X_6=0$ $X_7=1$	None $X_6=0$ $X_7=0$	Market wide $X_8=0$	Individual $X_8=1$	Manufacturing milk base $X_9=0$	Economic $X_9=1$	Yes $X_{10}=1$	No $X_{10}=0$
1	14	X		X			X		X		X	
2	4	X		X			X		X			X
5	2	X		X				X	X		X	
6	1	X		X				X	X			X
9	3	X			X		X		X		X	
11	1	X			X		X			X	X	
17	8	X				X	X		X		X	
18	3	X				X	X		X			X
19	5	X				X	X			X	X	
21	7	X				X		X	X		X	
23	2	X				X		X		X	X	
25	3		X	X			X		X		X	
26	7		X	X			X		X			X
33	4		X		X		X		X		X	
34	4		X		X		X		X			X
41	4		X			X	X		X		X	
42	3		X			X	X		X			X
46	1		X			X		X	X			X

Sources: Dairy Division. *Federal Milk Order Market Statistics*, Stat. Bul. 248, and Supplements for 1958, 1959, 1960 and 1961. Agricultural Marketing Service, U.S. Department of Agriculture. 1959, 1960, 1961 and 1962. Milk Marketing Orders Division. *Federal Milk Order Market Statistics, Annual Summary for 1962*, Agricultural Marketing Service, U.S. Department of Agriculture. 1963.

to whether f_1 and f_2 may be linear or of some other functional form. To allow for non-linearities, I chose to estimate

$$\begin{aligned} Y_i &= \beta_2 + \beta_3 X_{i3} + \beta_4 X_{i4} + \cdots + \beta_{10} X_{i10} + \beta_{35} X_{i3} X_{i5} \\ &\quad + \beta_{45} X_{i4} X_{i5} + \beta_{36} X_{i3} X_{i6} + \cdots + \beta_{410} X_{i4} X_{i10} \\ &\quad + \beta_{56} X_{i5} X_{i6} + \beta_{57} X_{i5} X_{i7} + \cdots + \beta_{510} X_{i5} X_{i10} \\ &\quad + \beta_{67} X_{i6} X_{i7} + \cdots + \beta_{910} X_{i9} X_{i10} + \epsilon_i \\ &= \beta_2 + \sum_j \beta_j X_{ij} + \sum_k \sum_j \beta_{jk} X_{ij} X_{ik} + \epsilon_i \end{aligned} \tag{3}$$

The variable $X_{i6}X_{i7}$ was not computed since it is always zero by the definitions of X_{i6} and X_{i7}. $X_{i5}X_{i9} = X_{i9}$, showing that every order containing an economic class I price formula also contained a seasonal class I differential plan. The two variables $X_{i6}X_{i9}$ and $X_{i7}X_{i8}$ were zero for every observation; no order contained both a base-excess plan and economic class I price formula; and no order contained both a Louisville plan and an individual handler pool.

Equations (1) and (3) were estimated for each year 1959 through 1962. To find a function that was simpler than (3) that would adequately measure effects of federal order provisions, equations (4) and (5) also were estimated.

$$Y_i = \beta_2 + \beta_3 X_{i3} + \beta_4 X_{i4} + \cdots + \beta_{10} X_{i10} + \epsilon_i \tag{4}$$

$$\begin{aligned} Y_i &= \beta_2 + \beta_3 X_{i3} + \beta_4 X_{i4} + \cdots + \beta_{10} X_{i10} + \beta_{35} X_{i3} X_{i5} \\ &\quad + \beta_{45} X_{i4} X_{i5} + \beta_{36} X_{i3} X_{i6} + \cdots + \beta_{410} X_{i4} X_{i10} + \epsilon_i \end{aligned} \tag{5}$$

Implications for intermarket price relationships are derived from (3), (4), or (5). Consider any two markets, say, i and s. From (3),

$$Y_i - Y_s = \sum \beta_j (X_{ij} - X_{sj}) + \sum_k \sum_j \beta_{jk} (X_{ij} X_{ik} - X_{sj} X_{sk}) + \epsilon_i - \epsilon_s$$

expresses the difference between the blend prices as a function of difference in class I utilization ratios, difference in distance from Eau Claire, and differences in federal order provisions in the two markets. Letting $\Delta Y_i = Y_i - Y_s$ and $\Delta X_{ij} = X_{ij} - X_{sj}$, and assuming $\epsilon_i = \epsilon_s$,

$$\Delta Y_i = \sum \beta_j \Delta X_{ij} + \sum \sum \beta_{jk} (X_{ij} \Delta X_{ik} + X_{ik} \Delta X_{ij} - \Delta X_{ij} \Delta X_{ik}). \tag{6}$$

For $j, k \geq 5$, the only possible values of ΔX_{ij} are zero and plus or minus one; $\Delta X_{ij} = 1$ represents a change from an order lacking a specified provision to an order containing that provision. From (6) we obtain

$$\frac{\Delta Y_i}{\Delta X_{ij}} = \beta_j + \sum_k \beta_{jk} (X_{ik} - \Delta X_{ik}) \tag{7}$$

If we set the products $\Delta X_{ij} \Delta X_{ik} = 0$, (7) is replaced by

$$\frac{\Delta Y_i}{\Delta X_{ij}} = \beta_j + \sum_k \beta_{jk} X_{ik} \tag{8}$$

Effect of price support activities

The reasons for selecting the years 1959–62 are indicated in Table 2. U.S. Department of Agriculture purchases of milk solids rose substantially between 1959–60 and 1961–62. (There have also been considerable differences in more recent years in the level of support prices and in purchases of solids, but data for these years were not available at the time this study was begun.)

Table 2. Solids content of dairy products removed from the commercial market by programs of U.S. Department of Agriculture, as percentage of marketings; and announced support prices for manufacturing milk

Calendar year	Solids content of removals as percentage of		Support price per 100 pounds
	Milk fat marketings	Solids-not-fat marketings	dollars[a]
1959	2.9	9.1	3.06
1960	2.9	8.9	3.11
1961	7.0	11.2	3.36
1962	9.1	14.3	3.18

[a] Computed as weighted averages of support prices for marketing years beginning April 1.

Source: *Supplement for 1963–64 to Dairy Statistics through 1960,* USDA ERS Suppl. for 1963–64 to Stat. Bul. 303, 1965.

The hypothesis that intermarket price relationships are affected by support activities was tested by using covariance analysis to test the hypothesis that the values of the β's remained the same from year to year. The hypothesis that the intercept, β_2, and the slopes, β_3 to β_{910}, remained the same from year to year was tested by use of an F ratio, say $F(SL; INT)$. The hypothesis that the values of the slopes remained the same from year to year (intercepts unspecified) was tested by use of another F ratio, say $F(SL)$. These two F ratios are discussed by Johnston [6, pp. 136–138] and by Foote [3, pp. 180–183].

If $F\ (SL; INT)$ and $F(SL)$ are nonsignificant in comparisons of 1959 with 1960 and 1961 with 1962 but significant in comparisons of all four years, this will verify the hypothesis that changes in price support activities influence intermarket price relationships.

Hypotheses

Table 3 summarizes the hypotheses. Several come directly from the studies summarized previously. The fourth is included because one purpose of supply-demand adjusters is to make class I prices more responsive to variations in class I utilization ratio (X_{i4}); this would tend to make the blend price more responsive to X_{i4}. The fifth is included because it is expected that the amount by which blend price in an individual handler pool exceeds the blend price in a market wide pool is related to the class I utilization ratio. The last four are included because Williams [11] and the Federal Milk Order

Table 3. Hypotheses

Hypothesis number	Hypothesis[a]	Source
1a	$\beta_2>0$	Babb [1] and text.
1b	β_2 positively correlated with support price	
2a	$\beta_3>0$	Babb [1] and text.
2b	β_3 negatively correlated with support price	
3	$\beta_4>0$	Babb [1] and text.
4	$\beta_{410}>0$	See text
5	$\beta_{48}>0$	See text
6	$\frac{\Delta Y}{\Delta X_{i8}}>0$	Babb [1] Graf and Steiner [8]
7	$\frac{\Delta Y_i}{\Delta X_{i9}}>0$	Babb [1]
8	$\frac{\Delta Y_i}{\Delta X_{i5}}\neq 0$	See text
9	$\frac{\Delta Y_i}{\Delta X_{i6}}\neq 0$	See text
10	$\frac{\Delta Y_i}{\Delta X_{i7}}\neq 0$	See text
11	$\frac{\Delta Y_i}{\Delta X_{i10}}\neq 0$	See text

[a] Hypotheses 6, 7, 8, 9, 10, 11 stated in terms of (8).

Study Committee [2] suggested that supply-demand adjusters and seasonal pricing plans may influence intermarket relationships, but they do not indicate the direction of the effects.

Results[2]

Covariance analyses

Results of $F(SL)$ and of $F(SL; INT)$ are summarized in Table 4.[3] The results accept the hypothesis that the slopes $\beta_3, \beta_4, \cdots, \beta_{910}$ were the same in each sample year and reject the hypothesis that the intercept had the same value each year. This means that variations in the dairy support price level affect blend price in all markets by the same amounts. Data for the four years can be pooled to obtain common estimates of the slopes. The results summarized in the rest of this paper were obtained using pooled data; pooling the data yielded 292 observations and from 260 to 289 degrees of freedom for t tests.

Table 4. Results of covariance analyses: significance or nonsignificance of F ratios for comparisons of results from various years

Years compared	$F(SL; INT)$	$F(SL)$
1959 and 1960	nonsignificant	nonsignificant
1961 and 1962	significant	nonsignificant
1959, 1960, 1961, and 1962	significant	nonsignificant

Statistics for equation (3.a)

The search for a simple relation between blend price and order provisions did not succeed, since equation (3) had a significantly lower residual sum of squares than (4) or (5) and all three had significantly lower residual sums of squares than (1). Intermarket price relationships are affected by federal order provisions and the effect of one type of provision is influenced by the presence or absence of other provisions.

Deleting from (3) the variables with nonsignificant coefficients and re-estimating the modified equation with pooled data yielded equation (3.a) in Table 5.

The procedure that was applied to equation (3) to obtain (8) can be applied to (3.a) to obtain values of $\Delta Y/\Delta X_j$. The results are:

$$(9) \quad \frac{\Delta Y}{\Delta X_3} = 10^{-3}(0.70 + 0.42X_5 - 0.21X_6 - 1.06X_7 + 0.16X_{10})$$

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[2] Mileage data were obtained from *Standard Highway Mileage Guide*, New York, Rand McNally, 1961. Other data were obtained from sources cited in the footnote to Table 1.

[3] Throughout this paper, "highly significant" means significant at the 1 percent level; "significant" means significant at the 5 percent level.

Table 5. Pooled results for 1959-62 for equation (3.a)

Variable	Coefficient[a]	Standard error
3	0.00070***	0.00007
4	0.02554***	0.00307
5	0.67036***	0.21012
6	−0.46878***	0.16539
7	1.10588***	0.32303
8	−0.93127***	0.27348
9	−3.73754***	0.32798
3.5[b]	0.00042***	0.00008
4.5	−0.01475***	0.00283
3.6	−0.00021***	0.00006
4.6	0.00928***	0.00231
3.7	−0.00106***	0.00027
4.7	−0.00920***	0.00412
4.8	0.01016***	0.00308
4.9	0.04603***	0.00348
3.10	0.00016**	0.00008
4.10	−0.00437***	0.00107
5.7	−0.34498***	0.08197
5.8	0.23493***	0.09040
5.10	0.24970***	0.05463
6.8	−0.26860***	0.05605
6.10	−0.09252***	0.04709
7.9	0.70943***	0.22308
7.10	0.33467***	0.08984
8.9	−0.39959***	0.08142
9.10	0.81969***	0.14816
b_2 for 1959	1.96591***	0.23277
b_2 for 1960	2.05424***	0.23151
b_2 for 1961	2.09561***	0.23131
b_2 for 1962	1.92757***	0.23133
R^2	0.940	

[a] *** means highly significant; ** means significant.
[b] $j \cdot k$ means $X_{ij}X_{ik}$; for example 3·5 means $X_{i3}X_{i5}$.

$$\frac{\Delta Y}{\Delta X_4} = 10^{-2}(2.55 - 1.47X_5 + 0.93X_6 - 0.92X_7 + 1.02X_8 + 4.60X_9 - 0.44X_{10}) \tag{10}$$

$$\frac{\Delta Y}{\Delta X_5} = 10^{-2}(67.04 + 0.042X_3 - 1.47X_4 - 34.50X_7 + 23.49X_8 + 24.97X_{10}) \tag{11}$$

$$\frac{\Delta Y}{\Delta X_6} = 10^{-2}(-46.88 - 0.021X_3 + 0.93X_4 - 26.86X_8 - 9.25X_{10}) \tag{12}$$

$$\frac{\Delta Y}{\Delta X_7} = 10^{-1}(11.06 - 0.011X_3 - 0.092X_4 - 3.45X_5 + 7.09X_9 + 3.35X_{10}) \tag{13}$$

$$(14)\quad \frac{\Delta Y}{\Delta X_8} = 10^{-1}(-9.31 + 0.10X_4 + 2.35X_5 - 2.69X_6 - 4.00X_9)$$

$$(15)\quad \frac{\Delta Y}{\Delta X_9} = -3.74 + 0.046X_4 + 0.71X_7 - 0.40X_8 + 0.82X_{10}$$

$$(16)\quad \frac{\Delta Y}{\Delta X_{10}} = 10^{-2}(0.016X_3 - 0.44X_4 + 24.97X_5 - 9.25X_6 + 33.47X_7 + 81.97X_9)$$

$\Delta Y/\Delta X_j$ measures the difference between the blend prices in two orders that are alike, except that the value of X_j for one order is one unit greater than the value of X_j for the other order. For example, suppose two markets have the same class I utilization ratio, are located the same distance from Eau Claire and are alike in all other order provisions, but order i has an individual handler pool and order s has a market wide pool. Then $X_{i8}=1$, $X_{s8}=0$, $\Delta X_8=X_{i8}-X_{s8}=1$ and $\Delta Y/\Delta X_8=\Delta Y=Y_i-Y_s$. From (14) we see that the difference between the blend prices in these two orders (ΔY) depends upon their common class I utilization ratio (X_4), whether they have a seasonal class I price differential (X_5), a base excess plan (X_6), or an economic class I price formula (X_9). Suppose both markets have a seasonal class I price differential ($X_5=1$), a base excess plan ($X_6=1$) and a manufacturing milk class I price formula ($X_9=0$). Then $Y_i-Y_s=10^{-1}\ (-9.31+0.1X_4+2.35-2.69)=-0.965-0.010X_4$. If neither has a base excess plan, but both have seasonal class I price differentials and manufacturing milk class I price formulas, $Y_i-Y_s=10^{-1}\ (-9.31+0.10X_4+2.35)=-0.696+0.010X_4$.

Estimated blend prices

Estimated prices and values of (9) and (10), computed from (3.a), are shown in Table 6 for the nonempty classes or orders. Some classes or orders are consistently high priced and others are consistently low priced. Classes 11, 17, 19, 23, 26, 33, 34 and 42 are among the 6 highest priced classes in 3 or more of the 6 columns. Classes 5, 9, 18, 25, 41 and 46 are among the 6 lowest priced classes in 3 or more of the 6 columns.

Tests of hypotheses

Hypotheses 1 to 3.—Hypotheses 1a, 1b, 2a and 3 are accepted. These hypotheses are: (1a) Eau Claire class II price is positive; (1b) β_2 is positively correlated with support price, (2a) blend price is positively related to distance from Eau Claire; and (3) blend price is positively correlated with class I utilization ratio. Hypothesis 2b (β_3 negatively correlated with support price) is rejected.

Hypotheses 4 and 5.—Hypothesis 4, which states that the presence of a

Table 6. Some effects of federal order provisions, 1962, estimated using equation (3.a)

Order class	Annual order blend prices						Increase in order blend price per 100 mile increase in distance	Increase in order blend price per one point increase in utilization ratio
	Class I utilization ratio							
	60 percent			90 percent				
	Miles distant from Eau Claire			Miles distant from Eau Claire				
	100	500	1,500	100	500	1,500	100 $\Delta Y/\Delta X_1$	$\Delta Y/\Delta X_4$
1	2	3	4	5	6	7	8	9
	dollars per hundredweight						*cents*	
1	3.34	3.76	4.83	3.81	4.23	5.30	10.7	1.57
2	3.42	3.79	4.70	4.03	4.39	5.30	9.1	2.01
5	2.98	3.41	4.48	3.76	4.18	5.25	10.7	2.59
6	3.07	3.43	4.34	3.98	4.34	5.25	9.1	3.03
9	3.80	3.89	4.11	3.72	3.80	4.02	2.2	−0.28
11	4.35	4.44	4.66	5.65	5.74	5.96	2.2	4.32
17	3.36	3.87	5.15	3.55	4.07	5.35	12.8	0.64
18	3.36	3.81	4.93	3.68	4.13	5.25	11.2	1.08
19	3.20	3.72	5.00	4.78	5.29	6.57	12.8	5.24
21	3.27	3.79	5.07	3.77	4.28	5.56	12.8	1.66
23	2.72	3.23	4.51	4.60	5.11	6.39	12.8	6.26
25	3.26	3.52	4.17	4.17	4.43	5.08	6.5	3.04
26	3.60	3.79	4.28	4.64	4.84	5.33	4.9	3.48
33	4.07	3.99	3.79	4.43	4.35	4.15	−2.0	1.19
34	3.98	3.83	3.47	4.47	4.32	3.96	−3.6	1.63
41	3.28	3.63	4.49	3.92	4.26	5.12	8.6	2.11
42	3.53	3.81	4.51	4.30	4.58	5.28	7.0	2.55
46	3.21	3.49	4.19	4.28	4.56	5.26	7.0	3.57

supply-demand adjuster makes blend price more responsive to class I utilization ratio, is rejected. A possible explanation for the negative value of b_{410} relates to the downward trend in X_4 most markets have experienced. Writing $\Delta Y/\Delta X_4 = .026 - .004X_{10} + \cdots$, we see that blend price is reduced less for a given decrease in X_4 if the market has a supply-demand adjuster. Supply-demand adjusters have cushioned the price depressing effects of decreases in X_4. This supports the position of the Federal Milk Order Study Committee: "At best, experience with these adjusters as they have been administered has been that. . . they have not served as effective tools for reducing persistently excessive supplies" [2, pp. II-1-13 to II-1-14].

Hypothesis 5 is accepted: $b_{48} > 0$. $\Delta Y/\Delta X_4$ is 1.02 cents greater if the two markets compared have individual handler pools than if they have market wide pools. $\Delta Y/\Delta X_8$ is 10.2 cents greater if the two markets have 90 percent class I utilization ratios than if they have 80 percent class I utilization ratios.

Hypothesis 6.—This hypothesis states that orders with individual handler pools have higher blend prices than orders with market wide pools. The results confirm this hypothesis for some situations and reject it for others. The maximum value of $\Delta Y/\Delta X_8$ is $0.010X_4 - 0.696$, which is positive if $X_4 < 69.6$. The minimum value of $\Delta Y/\Delta X_8$ is $.010X_4 - 162.7$, which is negative for every value of X_4.

Existing orders with individual handler pools do have high blend prices on

$\Delta Y/\Delta X_9 > 0$ if $X_4 > 63.5$. Six of the 8 markets containing economic class I formulas in 1962 had values of X_4 exceeding 63.5. If orders with economic class I formulas lacked supply-demand adjusters, $\Delta Y/\Delta X_9 = -3.74 + 0.046X_4$. This is positive only if $X_4 > 81.3$. None of the markets containing economic class I formulas in 1962 had values of X_4 exceeding 81.3. The fact that existing orders with economic class I formulas tend to have high blend prices is due to the kind of class I formula they contain and to the presence of supply-demand adjusters in these orders.

Orders with economic class I formulas are not necessarily high priced orders. Of the 26 "low price classes" in Table 6 Extended, 13 have economic class I price formulas and 13 have manufacturing milk formulas. Of the 13 with economic class I formulas, all are empty; of the 13 with manufacturing milk formulas, only 2 are empty.

The positive sign on b_{49} may reflect supply conditions in the east and northeast, where markets with economic class I price formulas are located. Farmers in these areas generally have fewer good alternatives to dairying than do farmers in other areas. This tends to make supply less price-elastic. As a result, larger variations in price are needed to induce given variations in supply.

If we accept the positive signs of b_{49} and b_{910}, the sign of b_9 has to be negative to avoid unreasonable blend price differences. Suppose $b_9 \geq 0$ and $X_4 = 75$ (about the national average in 1962). Then $\Delta Y/\Delta X_9 = b_9 + \$4.27$. If b_9 were non-negative, a class I utilization ratio of 75 would result in a blend price that was at least \$4.27 higher if the order contained an economic formula than if it contained a manufacturing milk formula. With $b_9 = -\$3.74$ and $X_4 = 70$, $\Delta Y/\Delta X_9 = \$0.53$.

Hypotheses 8, 9, and 10.—These hypotheses state that blend prices are related to seasonal pricing plans. The results confirm these hypotheses for most situations. $\Delta Y/\Delta X_5$, $\Delta Y/\Delta X_6$, and $\Delta Y/\Delta X_7$ may be negative or positive. The use of different seasonal pricing arrangements does affect annual blend price relations. The effect of each one of the seasonal pricing plans on blend price is influenced by X_3, X_4, and X_{10}.

Hypothesis 11.—This hypothesis states that the presence of a supply-demand adjuster affects blend price. $\Delta Y/\Delta X_{10}$ is positive in some situations and negative in others. Some effects of supply-demand adjusters have already been mentioned in discussions of hypotheses 4 and 7.

Williams et al. [11] showed how the effects of seasonal price plans and of supply-demand adjusters may reinforce or offset each other. The coefficients of X_5, X_6 and X_7 in (16) also show this. For example, if $X_5 = X_6 = X_7 = X_9 = 0$, then $\Delta Y/\Delta X_{10} = 0.00016X_3 - 0.0044X_4$; if $X_5 = 1$ and $X_6 = X_7 = X_9 = 0$, then $\Delta Y/\Delta X_{10} = 0.00016X_3 - 0.0044X_4 + 0.25$; if $X_5 = X_7 = 1$ and $X_6 = X_9 = 0$, then $\Delta Y/\Delta X_{10} = 0.00016X_3 - 0.0044X_4 + 0.58$.

Hypotheses 6 to 11 could be tested by using the procedure discussed by

Fuller [4] to compare each $\Delta Y/\Delta X_j$ with its standard error. This was not done because of the expense. Even if we restricted X_3 to 4 possible values and X_4 to 3 possible values, there would be a total of 560 values of $\Delta Y/\Delta X_j$ to compute, as well as 560 different variances. However, this procedure was applied to a simpler equation than (3.a). Almost all values of $\Delta Y/\Delta X_j$ were substantially greater in absolute value than their standard errors, indicating rejection of the hypotheses $\Delta Y/\Delta X_j = 0$.

Empty classes

Of the 48 possible classes of orders, 30 are empty. Results from (3.a) show that many are empty because their particular combinations of order provisions provide unreasonable results in the form of: (a) unduly high blend prices, (b) unduly low blend prices, (c) undue sensitivity to variation in X_4, or (d) inappropriate effects of variations in X_3.

As explained, Table 6 Extended is obtained from Table 6 by filling in all columns for all classes of orders, including the empty classes. Let U_i, U_j, U_k, $\cdots$, identify empty classes. $U_i \leq 48$ and U_i is a number not appearing in column 1 of Table 6; U_j, U_k, $\cdots$ are similarly described. For example, $U_i = 3$ identifies order class 3, which is empty. Let C identify one of the columns 2 through 7 of Table 6 and Table 6 Extended. C = 5 identifies column 5. The lowest and highest values of $\hat{Y}$ in columns 2–7 of Table 6 are:

Column 2: \$2.72 and \$4.35
Column 3: \$3.23 and \$4.44
Column 4: \$3.47 and \$5.15
Column 5: \$3.55 and \$5.65
Column 6: \$3.80 and \$5.74
Column 7: \$3.96 and \$6.57

In the following, the expression "Classes U_i and U_j are P percent low priced in column C" means that values of $\hat{Y}$ for classes U_i and U_j in column C of Table 6 Extended are P percent or more below the smallest value of $\hat{Y}$ in column C of Table 6. Similar expressions are interpreted similarly. For example, "Classes 4 and 7 are 10 percent low priced in column 2" means that the values of $\hat{Y}$ for order classes 4 and 7 in column 2 of Table 6 Extended are 10 percent or more below \$2.72.

The emptiness of classes 4, 7, 8, 20, 24, 31, 32, 47, and 48 is explained by (b) and (c). These classes are 10 percent low priced in columns 2 and 3. The values of $\Delta Y/\Delta X_4$ for these empty classes range from 5.7 cents to 9.1 cents; all are larger than all but one of the values in column 9 of Table 6.

The emptiness of classes 36 and 40 is explained by (b), (c), and (d). Class 36 is 8 percent low priced in column 4; class 40 is 12 percent low priced in column 3. These classes have large values of $\Delta Y/\Delta X_4$. They have negative values of $\Delta Y/\Delta X_3$, indicating there would be a tendency for blend price to decline with increasing distance from Eau Claire for these classes.

The emptiness of classes 35 and 39 is explained by (a), (c), and (d). Class 35 is 7 percent high priced in columns 2, 5, and 6. Class 39 is 5 percent high priced in column 6. These two classes also have high values of $\Delta Y/\Delta X_4$ and negative values of $\Delta Y/\Delta X_3$.

The emptiness of class 38 is due to (b) and (d). This class is 8 percent low priced in column 4 and has a negative value of $\Delta Y/\Delta X_3$.

Classes 3, 15, 16, 27 and 43 may be empty because of their large values of $\Delta Y/\Delta X_4$: from 5.3 cents to 7.6 cents. $\Delta Y/\Delta X_3$ was slightly negative for each class from 33 to 40. All of these classes except 33 and 34 were empty. All markets in class 33 were between 600 and 630 miles from Eau Claire, and all markets in class 34 were between 350 and 510 miles from Eau Claire.

I hypothesize that these findings on empty classes reflect the operations of the Agricultural Marketing Service, Dairy Division, which had the responsibility of administering orders. Through experimentation with various combinations of provisions, they found that certain combinations would give undesirable or unacceptable results if used. Consequently, the Dairy Division issued no orders containing these particular combinations; or else it had issued such orders and modified them prior to 1962.

Offsetting and reinforcing provisions

From comparisons of signs of coefficients in (11) through (16), it can be seen that different provisions may reinforce or offset each other. For example, if $X_3=1{,}000$, $X_4=70$, $X_8=X_{10}=1$ and $X_7=0$, then $\Delta Y/\Delta X_5=44$ cents, but $\Delta Y/\Delta X_6=-39$ cents; also $\Delta Y/\Delta X_5+\Delta Y/\Delta X_6=5$ cents and $\Delta Y/\Delta X_5-\Delta Y/\Delta X_6=83$ cents. The effect of having a seasonal class I differential plan can be largely offset by having a base-excess plan. The effect of a seasonal class I price differential is enhanced by the absence of a base-excess plan. If $X_3=1{,}000$, $X_4=70$, $X_5=X_6=X_9=1$ and $X_7=0$, then $\Delta Y/\Delta X_8=-97$ cents, but $\Delta Y/\Delta X_{10}=83$ cents. The effect of having an individual handler pool is nearly offset by having a supply-demand adjuster.

Summary

Variations in the dairy support price level apparently affect blend prices in all markets by the same amount.

The relation of blend price to class I utilization ratio and distance from Eau Claire is affected by federal order provisions; the relation of blend price to one order provision is affected by other order provisions and by distance and class I utilization ratio.

Supply-demand adjusters have cushioned the blend price depressing effects of decreases in class I utilization ratio.

Existing orders having individual handler pools have high blend prices on the average. This is due to a combination of circumstances: (a) These orders have high class I utilization ratios; (b) they contain seasonal class I price differentials; (c) several combinations of other order provisions with individual handler pool provisions result in low blend prices. Few existing orders have these particular combinations of provisions.

Existing orders containing economic class I price formulas have high blend prices on the average. This is due to a combination of circumstances: (a) Most of these orders contain supply-demand adjusters; (b) several combinations of other provisions with economic price formulas result in low blend prices. No existing orders contain these particular combinations of provisions.

Effects of various seasonal pricing plans can reinforce or offset effects of other seasonal pricing plans and of supply-demand adjusters.

The results of this study point up the importance of the problem that concerned the Federal Milk Order Study Committee when it wrote: "The practice of varying the terms of the orders from market to market tends to magnify these problems of intermarket relationships" [5, p. II-4-1]. There is a conflict between the objective of maintaining reasonable intermarket relationships and the objective of adapting each order as closely as possible to the local market environment. The results of this study argue that the criteria used by the Dairy Division in formulating orders have been tied too closely to local market conditions and have not paid sufficient attention to intermarket relations.

The results raise the question: Since some provisions reinforce each other and others offset each other, are all the existing provisions needed?

Several combinations of provisions are unused because they provide unreasonable results: unduly low or high prices, oversensitivity to variations in class I utilization ratio, or decreases in blend price with increasing distance from Eau Claire.

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Predicting Aggregate Milk Production: An Empirical Study

GLENN A. ZEPP AND ROBERT H. MCALEXANDER

There is a need for predictive and aggregate output response models suitable for answering questions about short-term changes in agricultural output. In this study, short-term milk output projections for Southeast Pennsylvania between 1961 and 1965 were derived with a linear programming, a recursive programming, and a regression model. The predictiveness of each model is evaluated by comparing its estimate of aggregate milk production with reported output for target years. Differences are expressed as percentage error from reported production.

PUBLIC policy makers, agricultural program administrators, and farm leaders often need knowledge of expected changes in agricultural production one or two years hence. Usually their inquiries will focus on what level of output will *most likely* be produced, and their interest will be areal, regional, or national in scope rather than limited to farm level. There is a need for predictive and aggregate output response models suitable for answering such questions about short-term changes in agricultural production.

Generally, empirical studies of agricultural output response can be categorized into one of two types: (1) historical or (2) synthetic. Nerlove and Bachman have reviewed the formal approaches and discussed some problems encountered in estimating farm output response [4]. Historical studies, mostly regression analysis, are based on examination of farmers' past responses to observable independent variables. Output projections from such an analysis are developed by extending past relationships into the future and are not founded on any well-defined theory of production.

Synthetic studies, primarily linear programming in recent years, are based on an economic analysis of the conditions underlying the production process. Such an analysis is more adaptable than the regression technique for studying the effects upon output of future changes in production conditions.

The linear programming approach gives profit-maximizing output estimates that usually are considerably greater than actual production. Recently, much effort has been devoted to improving the predictive quality of the linear programming model by introducing "flexibility" constraints to limit the yearly rate of adoption of new technology and change in enterprise combinations to those rates experienced in the past.[1] Such a

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[1] This technique utilizes the concept of a cobweb model where production is esti-

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model has aspects of both the historical and the synthetic approaches. The direction of change in output is determined through a synthetic-type model within the production theory framework. The extent of any change, however, is limited by flexibility constraints, thus reflecting the historical aspects of the model. The method has been termed recursive linear programming, hereafter called recursive programming. Some examples of the recursive programming technique are reported by several economists [1, 2, 3, 8].

Very few studies have compared the effectiveness of these different methods for estimating future agricultural production. One such study is reported by Schaller and Dean [8] in which regression and recursive programming estimates of cotton and alternative crops in Fresno County, California, were compared with reported production.

The purpose of this paper is to compare the predictive quality of a linear programming, a recursive programming, and a regression model in estimating short-term (1- to 5-year) changes in an area's milk production. Output estimates were derived with each type model and results compared with the milk production reported for the area.

Procedures

The analysis was based on the dairy industry for a 15-county area in southeastern Pennsylvania between 1960 and 1965. The area was selected to represent homogeneous farm and nonfarm economic opportunities. Resources available for dairying during 1960 were estimated from a 1961 survey of 1.5 percent of the commercial dairy farms in the area.[2] Prices and technical coefficients generally were chosen to represent the average for the study area. Some technical coefficients changed from year to year in the recursive programming analysis, reflecting the tendency for area crop and livestock production and fertilization and feeding rates to increase over time. The appropriate milk price was defined as the simple average of prices received in the study area during the two years immediately preceding production. Following are milk prices per hundredweight used in the analysis:[3]

Year	*Price*
1961	$5.00
1962	5.02
1963	4.93
1964	4.76
1965	4.82

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mated year-by-year using production and price from year t to predict production for year $t + 1$.

[2] Commercial dairy farms were defined as those reporting milk sales during 1960.

[3] In projecting with the recursive programming model, a supply-demand analysis is usually needed in order to generate the milk price on which to estimate the following year's production. In this study, however, actual prices were used.

Sample farms were divided among 5 homogeneous resource groups so as to reduce aggregation bias in the linear programming output estimates.[4] The total of resources on all farms within each group was defined as a resource situation and was analyzed as one large operation. Programming-type milk output estimates for all the resources situations were summed and expanded by the reciprocal of the sampling rate to arrive at area estimates.

The linear programming estimate was a 5-year projection. Resources on sample farms during 1960 and prices and production technology representing 1965 were used in deriving linear programming estimates of 1965 milk production. The results were interpreted as the aggregate milk output, the enterprise combination, and resource-use changes that would occur within 5 years.

A series of 5 area milk output estimates for 1961 through 1965 were developed within the recursive programming model. Fixed resources for a particular year were defined as those resources employed during the previous year. The previous year's resources, in turn, consisted of its fixed resources adjusted for any change made through expansion or contraction activities within the programming analysis for that year. The initial resource situation was the same as that used in the linear programming model.

Regression estimates of area milk production for 1961 through 1965 were based on time-series data starting with 1950. One-year projections were developed for each of the 5 years, 1961 through 1965.[5] Then 2-year, and in turn, 3-, 4-, and 5-year projections were developed for each of the 5 test years. Regression parameters were revised for estimating each succeeding year's output to take advantage of the additional year of data in the time-series. For example, the 1-year projection of 1961 milk output was based on data for 1950 to 1960, while the 1962 1-year projection was based on 1950–1961 data. The 2-year projection of 1961 output was based on 1950 to 1960 data. The length of the time-series was extended year by year to 1962, 1963, and 1964, respectively, for the 1963, 1964, and 1965 1-year projections; and to 1961, 1962, and 1963, respectively, for the 1963, 1964, and 1965 2-year projections.

Estimates from each type model were evaluated by comparing them with reported production for their respective years. The difference between an estimate and reported production was expressed as percentage error from reported output.

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[4] The logic of the classification procedure is presented by Sheehy and McAlexander [9]. The details of the procedure are presented in Zepp, [12, p. 203].

[5] For the regression model the length of projection indicates the time between the last observation in the time-series data and the target date.

Programming model

The linear programming model was intended to incorporate the most important economic, technological, and institutional forces influencing milk production in the study area.[6] Activity vectors represented the major livestock and field crops raised on southeastern Pennsylvania farms. Off-farm employment at $1.25 per hour, representing a movement of labor out of agriculture, also was included in the model as an alternative use for labor. A transfer activity permitted shifting dairy housing to use for beef, but beef housing could not be used for dairying. Other activities included milk sales, corn grain purchases, bedding material purchases, silo capacity expansion, and dairy housing capacity expansion.

Resource restraints in the linear programming model were for cropland, pastureland, silo capacity, family and regular hired labor (four seasons), expansion capital, bedding materials, and housing capacity for dairy, beef, hogs, and laying hens.[7] Rotation restraints were included to specify upper limits on the acreage of alfalfa and corn. Restraints also were included to keep the rate of grain feeding to dairy cattle within grain-to-milk ratios of 1:2 to 1:4. Other feeding constraints assured sufficient total disgestible nutrients for the livestock enterprises and limited per month forage consumption to 1/12 of the maximum permitted annual forage intake.

Some so-called "fixed resources"—cropland, pastureland, family and hired labor, silo capacity, and livestock housing facilities—could be adjusted within the linear programming framework. Farm use of family and hired labor could be decreased (increased) through off-farm employment (labor employment) vectors. Silo capacity and dairy housing expansion activities permitted increasing the existing supply of silage storage and dairy cattle housing. "Disposal" or "slack" activities permitted non-use of farm resources when it was profitable to do so. Some adjustment of farm resources also was made outside the linear programming framework as resources devoted to specialty crops in 1965, mainly vegetables, tobacco, and potatoes, were subtracted from the resource totals.

Flexibility constraints

In addition to the rows and columns of the linear programming matrix, the recursive programming model had six flexibility constraints limiting maximum year-to-year changes in resource use. These were intended to represent the many forces causing lags in resource adjustments, such as farmers' inability or unwillingness to make profitable changes because of risk, uncertainty, or personal preferences. The restraints were placed on the following activities: (1) off-farm employment of winter labor, (2) off-farm employment of spring labor, (3) off-farm employment of summer labor, (4) off-farm employment of fall labor, (5) expansion of dairy housing facilities, and (6) expansion of silo capacity. The magnitudes of these constraints were estimated as the average plus one standard deviation of percentage year-to-year changes in each resource during recent years.[8]

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[6] Similar linear programming models have been used in the northeast dairy adjustments study and other regional adjustments studies [5].

[7] In the recursive programming model, flexibility constraints on silo capacity expansion and dairy housing expansion replaced the expansion capital constraint.

Regression model

The following regression model was used in developing area milk output estimates for 1961 through 1965:

$$y_{0,t} = y_{1,t} \cdot y_{2,t} \tag{1}$$

$$\Delta y_{1,t} = a_1 + b_1 X_{1,t} + b_2 X_{2,t} + e_{1,t} \tag{2}$$

$$\Delta y_{2,t} = a_2 + b_3 \Delta y_{1,t} + e_{2,t} \tag{3}$$

where

$y_{0,t}$ = area milk output in year t,
$y_{1,t}$ = number of cows milked in the study area during year t,
$\Delta y_{1,t} = y_{1,t+1} - y_{1,t}$,
$y_{2,t}$ = average milk production per cow in the study area during year t,
$\Delta y_{2,t} = y_{2,t+1} - y_{2,t}$,
$X_{1,t}$ = hourly return from farming to operator and family labor in year t divided by the industrial production worker weekly payroll index for year t,[9]
$X_{2,t}$ = average milk price received by farmers in the Philadelphia milk marketing areas during the previous 2 years, $X_{2,t} = (P_t + P_{t-1}) \div 2$
a_i = vertical axis intercept,
b_i = slope coefficients,
e_{it} = random error term.

The regression parameters were estimated using the two-stage least-squares technique.

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[8] Flexibility constraints were estimated at 6 percent for off-farm employment, 4 percent for dairy housing expansion, and 9 percent for silo expansion.

[9] Return per hour from farming was for the Central Northeast dairy region [11]. Though the study area did not lie within the Central Northeast dairy region it was assumed that returns to operator and family labor would exhibit the same relationship in these 2 areas. Net returns for 1948 through 1956 were estimated by subtracting a capital charge, based on current interest rates, from farm income. For years 1957 through 1964, the interest rate used was 4.1 percent rather than the actual rates for those years. The industrial production worker weekly payroll index was compiled from reports of the U.S. Department of Labor [10, p, 460].

Results

The Pennsylvania Crop Reporting Service estimated area milk production for 1961 at 2,249.5 million pounds (Table 1). Production increased during 1962 and 1963, declined during 1964, and then increased slightly during 1965.

Table 1. Reported milk production and percent error of linear programming, recursive pogramming, and regression estimates, Southeastern Pennsylvania, 1961 through 1965

Year	Reported production[a]	Linear programming estimate	Recursive programming estimate	Regression estimates				
				One-year	Two-year	Three-year	Four-year	Five-year
	Million lbs.	*Percent error*	*Percent error*	*Percent error*	*Percent error*	*Percent error*	*Percent error*	*Percent error*
1961	2,249.5	—	−9.0	+ .4	−0.6	−4.3	−2.6	−2.1
1962	2,336.2	—	−1.9	−2.1	−1.6	−3.8	−6.7	−4.8
1963	2,376.7	—	+0.3	−0.1	−2.7	−2.2	−3.9	−8.1
1964	2,373.2	—	+4.2	+1.6	+1.3	−1.8	−1.2	−3.4
1965	2,375.5	+7.0	+7.5	+0.7	+2.8	+2.2	−1.3	−0.8
			(4.6)[b]	(1.0)	(1.8)	(2.9)	(3.1)	(3.8)

[a] Source: [6, 7].

[b] Figures in parenthesis are average absolute deviations.

The linear programming estimate of area milk production for 1965 was 2,540.9 million pounds, or 7 percent greater than reported output. Recursive programming estimates ranged from 2,046.4 million pounds for 1961, or 9 percent less than 1961 reported output, to 2,553.8 million pounds in 1965, or 7.5 percent more than 1965 reported production. The average deviation of estimate from actual production for the 5 years was 4.6 percent. Reported production declined slightly during 1964, whereas the recursive programming estimator predicted increases for every year.

The 1-year regression projections of area milk output ranged from a low of 2,259 million pounds in 1961, or about 0.4 percent more than reported production, to 2,411.8 million pounds in 1964, or 1.6 percent above 1964 output. Average deviations of estimates from reported production for the 5 years was about 1 percent. The largest error was 2.1 percent during 1962. The 1-year regression estimates indicated a decline in area milk output between 1964 and 1965 but did not predict the reported decline between 1963 and 1964.

Two-year regression projections ranged from 2,235.8 million pounds for 1961, or 0.6 percent less than reported output, to 2,441.8 million pounds in 1965, or 2.8 percent above reported production for that year. The average deviation of estimates from reported production over the 5 years was 1.8

percent and the largest error was 2.8 percent during 1965. The 2-year regression estimator did not predict the decline in reported area milk production between 1963 and 1964, but indicated increases each year from 1961 through 1965.

Average errors of estimate for the 3-, 4-, and 5-year projections were 2.9, 3.1, and 3.8 percent, respectively. Though the 1965 projections from these 3 estimators were close to reported output, the errors for some other years were high. The largest errors were 4.3, 6.7, and 8.1 percent, respectively, for the 3-, 4-, and 5-year projections.

The results seem to support the Schaller-Dean experience with predicting crop production [8]. As in this study, their regression models usually gave closer estimates of reported crop acreage and production (sometimes much closer) than the recursive programming model. Their recursive programming model tended to overestimate relatively small changes in acreage. They concluded that the recursive programming model may be more effective than regression when substantial changes in structure occur—such as the introduction of a new Government program.

Implications for Future Output Response Estimation

The programming-type models seem to be relatively poor estimators of reported production because they are basically normative tools, whereas regression is a predictive tool. Linear programming is a normative technique well suited for planning purposes, but its analysis is based on the optimization principle. For various reasons farmers in the aggregate do not optimize in the real world situation and linear programming estimates of production tend to be larger than actual output.

Recursive programming, as here defined, is an attempt to make a normative tool—that is, linear programming—more predictive by restricting changes in certain variables according to some criteria. In this study, historical magnitudes were used. This RP technique provides a predictive tool for use when structural changes would make regression results questionable.

Regression is a predictive tool and can reflect some of the forces influencing production that are difficult to take into account in the linear programming model. However, conditions underlying future production should generate similar relationships between variables as in the past if regression is to be a reliable predictive tool.

In this study, regression analysis seemed the most appropriate for projecting production variables. The two components of area milk production —number of cows milked, (y_1), and production per cow, (y_2)—continued trends established prior to the test years. The regression model was well suited to predict the changes occurring in these variables and hence gave close estimates of reported area production. The linear programming model overestimated actual production and the flexibility constraints tested in the recursive programming model did not improve the program-to March 31, for several thousand farm households[4] selected from Japan as a whole by stratified three-stage random sampling. One-person households were excluded from the survey.

Households were required to record income and expenditures (cash and in-kind) in the Family Account Book, which was verified by enumerators every month. In 1952, 1957, and 1962, part of the households in the survey were replaced, and the survey during these years was not based on identical families.[5]

In the time-series analysis the period dealt with is from 1951 to 1962, but the cross-section estimation covers only 1959–62 because cross-sectional data prior to 1959 were either unpublished or published without income information. The cross-sectional data represented single households classified by income into eight classes in 1959 and 1962 and seven in 1960 and 1961. The same information was also cross-classified by income and family size.

Since grouped data were used,[6] the number of households each year and in each income group was weighted in all equations.[7]

Cross-section Analysis

Engel curves are usually estimated by least-squares (LS) method, using measured income, Y, or total expenditure, C, as a regressor. According to the permanent income hypothesis, however, the LS estimates of the parameters of Engel curves using Y as an explanatory variable is biased downward. Also, Summers [10] has shown that the use of C as regressor in LS analysis leads to biased estimates, since individual expenditures are jointly determined with C.

On the basis of Summers' analysis, Liviatan [8] has developed a method to obtain consistent estimates of the parameters in the equation

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[2] The four food items are cereals, potato-bean-vegetable-processed food, fish-meat-eggs-milk, and condiments-desserts-food prepared outside household. Housing consists of rent-repairs-improvements and furniture-utensils.

[3] The survey is conducted and published by the Agricultural Economic Bureau, Ministry of Agriculture and Forestry, Japan. Each year it is published in somewhat different form. The 1962 survey, for example, was published in 11 volumes in 1964. The 1962 data were taken from Volume 6: *Statistics of Farm Households Budgets.*

[4] Sample sizes of the time-series data are from 5,609 to 5,781 during 1951–1961, but only 2,830 for 1962.

[5] Changes in sampling procedures are not likely to produce much distortion for the time-series analysis; because of the large number of households in the survey, yearly averaged data of the sample would not be greatly affected by rotating part of the households. Although this is not the reinterview data of the panel survey, the data of time series of budgets used in this study are scarce in most cases.

[6] Data for individual households are not available. It can be shown that, although the variances of linear estimators become larger when grouped rather than individual data are used, unbiasedness is not affected by grouping.

[7] All equations were estimated by CDC 3600 computer program, "Weighting of Observations in Least Squares Problems" of Michigan State University.

$$\log X_i^* = \alpha_i + \beta_i \log C^*, \qquad (i = 1, \cdots, m), \tag{1}$$

where X_i^* is the systematic part of the expenditure on the ith item, X_i, and C^* the systematic part of C (i.e., permanent consumption). Liviatan has shown that a consistent estimate of β_i can be obtained by using Y as an instrumental variable (IV) for C in the double-logarithmic regression of X_i on C. This procedure is equivalent to using the equations

$$\begin{aligned} \log X_i &= a_{0i} + a_{1i} \log Y \qquad (i = 1, \cdots, m) \\ \log C &= a_0 + a_1 \log Y, \end{aligned} \tag{2}$$

since $B_i = \hat{a}_{1i}/\hat{a}_1$, where $\hat{a}_{1i}$ and $\hat{a}_1$ are LS estimates of a_{1i} and a_1 in (2), is the IV estimate of β_i [8]. Accepting Friedman's basic hypothesis [1] that the elasticity of permanent consumption with respect to permanent income is unity, B_i can be interpreted as the permanent income elasticity. Note that the empirical results show that the B_i are not much different from the corresponding LS estimates of expenditure elasticities (η_E's) using data classified by C.[8]

It should be noted that the IV method eliminates the simultaneous bias in a large sample only under a constant set of preferences. Bias may arise if family size, N, is not included in the equations, since it is the most important variable in a set of preferences. To eliminate the N effect, the average C and X_i are sometimes adjusted by family size elasticities (η_N's) when using data classified by Y alone, if an average N is available for each Y class. Nevertheless, this method is only approximate. More often the figures of Y, C, and X_i per household are converted to a per capita basis, hopefully to eliminate the N effect. However, the conversion to per capita figures is probably inferior to the adjustment by η_N's because the relationship between N and expenditure is not proportional. In our data classified by Y, there is not much difference in N in each group, so that biases in the LS estimates of income elasticities (η_Y's) using (2) for most commodities are very small.

If households are grouped by Y and, in each group, the average N is different, it may be impossible to estimate reliable η_Y and η_N if Y and N are correlated as they often are in budget surveys. Reliable estimates can be obtained from data cross-classified by Y and N.[9] In order to compare the IV estimates with the LS estimates from data cross-classified by Y and N, the parameters were estimated by simple regression with Y as the sole regressor and by multiple regression with Y and N as regressors.[10] All the equations were in double-logarithmic form. The results are not much different for the four years. The estimates in 1962 only are shown in Table 1.

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[8] When grouped data are used, the regression of X_i on C should use the data classified by C. No farm budget data were classified by C. For the comparison of B_i and η_E, see [7]. Note also that, since in (2) the regressor is Y, the data grouped according to Y should be used when employing the IV method.

[9] See, e.g., [3] [7].

[10] The number of households in the cross-sectional equations for the four years 1959–1962 is 5,016, 5,352, 5,319, and 2,830 respectively.

Table 1. Demand relationships for basic living materials for farm households, 1962[a]

	Constant	Income elasticity	B_i	Family size elasticity	$\bar{R}^2(S)$
Simple regression					
Total expenditures	1.758 (.130)	.683 (.023)			.945 (.027)
Food	2.575 (.285)	.467 (.050)	.684		.625 (.059)
Cereals	2.965 (.493)	.333 (.086)	.487		.210 (.101)
Potato, bean, vegetables, and processed food	1.914 (.270)	.430 (.047)	.630		.611 (.056)
Fish, meat, eggs, and milk	.776 (.118)	.651 (.021)	.953		.950 (.024)
Condiments, desserts, and food prepared outside household	1.428 (.163)	.566 (.029)	.829		.883 (.034)
Housing	1.053 (.191)	.664 (.033)	.972		.884 (.039)
Rent, repairs, and improvements	1.313 (.198)	.553 (.035)	.809		.830 (.041)
Furniture and utensils	.290 (.274)[b]	.756 (.048)	1.106		.826 (.056)
Fuel and light	1.746 (.573)	.458 (.100)	.670		.276 (.118)
Clothing	−.586 (.186)	.925 (.033)	1.355		.939 (.038)
Multiple regression					
Total expenditures	1.928 (.065)	.631 (.012)		.177 (.014)	.987 (.013)
Food	2.993 (.056)	.339 (.010)		.434 (.012)	.986 (.011)
Cereals	3.696 (.065)	.108 (.012)		.759 (.014)	.987 (.013)
Potato, bean, vegetables, and processed food	2.300 (.082)	.312 (.015)		.401 (.018)	.965 (.017)
Fish, meat, eggs, and milk	.839 (.114)	.632 (.021)		.066 (.024)	.956 (.023)
Condiments, deserts, and food prepared outside household	1.624 (.101)	.506 (.018)		.203 (.021)	.957 (.020)
Housing	.926 (.167)	.703 (.032)		−.132 (.037)	.905 (.035)
Rent, repairs and improvements	1.186 (.185)	.591 (.034)		−.131 (.039)	.858 (.037)
Furniture and utensils	.170 (.271)[b]	.793 (.049)		−.124 (.058)[c]	.838 (.055)
Fuel and light	2.005 (.564)	.378 (.103)		.269 (.120)[c]	.329 (.114)
Clothing	−.465 (.173)	.888 (.032)		.126 (.037)	.950 (.035)

[a] Standard errors appear in the parentheses to the right of the coefficients.
[b] Denotes coefficients not significantly different from zero.
[c] Denotes coefficients significantly different from zero at 5% level.
All others (without notation) indicate coefficients significantly different from zero at 1% level.

Analysis of the estimates in 1962

All of the η_Y's in Table 1 are significantly positive at the .01 probability level. Of the 11 items, 4 show η_Y's below .5 and the rest show η_Y's between .5 and 1.0. The orders of magnitude of the η_Y's are generally as expected. It is natural that the η_Y is the lowest in cereals, and high in fish-meat-eggs-milk. The relatively high η_Y's in housing and clothing are in line with estimates in most previous studies.

Of course, the goodness of fit improves (i.e., $\bar{R}^2$ becomes larger) when a multiple regression is used. This is particularly evident for total food, cereals, and potato-bean-vegetables-processed food due to their large η_N's. If the η_N for a particular item is positive, its η_Y estimated by multiple regression is smaller than the corresponding figure estimated by using Y alone. The coefficient of the constant term, however, is larger than the corresponding coefficient obtained by a simple regression. When η_N is negative, the converse is true.

The η_Y's estimated by simple and multiple regressions are not much different in all items except cereals in consequence of its large η_N. The negative η_N's of housing and its components are due to the fact that as an increase in N makes the family relatively poorer, the family, after an increase in expenditures on relatively necessary goods such as food, cannot but spend less on housing. As the $\bar{R}^2$ for fuel-light is very low, the demand for the group does not seem to be determined by Y and N alone.

The B_i are considerably larger than their corresponding η_Y's. Since the B_i are consistent estimates of the "true" expenditure elasticities, β_i, and since they can be interpreted as the estimates of the permanent income elasticities, the η_Y's obtained by LS are underestimated.

Evidence from other budget studies

Nearly all other budget studies were based on non-farm data. Our results are not always directly comparable with those obtained by others because of different coverages, regression methods employed, classification of commodities, etc. Moreover, it would carry us too far to enter upon a detailed comparison.

Studies employing double-logarithmic equations were made by Tobin [11], Houthakker [3], and Yuize [12, 13, 14]. Using 1941 U. S. budget data for an analysis of the demand for food, Tobin [11] obtained $\eta_Y = .56$ and $\eta_N = .25$ for urban households, and $\eta_Y = .35$ for farm households.[11] In this international comparison of household expenditure patterns, Houthakker [3] used nearly all survey data conducted after World War II and a number of older surveys to estimate η_E's and η_N's for food, housing (including fuel-light), clothing, and miscellaneous items. The range of η_E's for the four items estimated from various surveys is fairly narrow but not equal; and the η_N's for food and miscellaneous items are similar, but those for clothing and housing irregular, among countries. On the basis of his estimates, Houthakker maintains that, if a country has no expenditure survey data available, it would not be too biased by assuming η_E at .6 for food, 1.2 for clothing, .8 for housing, and 1.6 for miscellaneous items; and η_N at .3 for food, zero for housing and clothing, and $-.4$ for miscellaneous items.

Comparing our multiple regression results with Houthakker's Table II (the results were estimated from 35 surveys data cross-classified by Y and N), we find that our small η_N's for housing and clothing are in accord with his and that our η_N for food is larger and η_Y's for food, housing[12] and clothing are smaller than almost all of his estimates. It should be noted that Houthakker used no farm data and used C rather than Y as the explanatory variable.[13] η_E should be greater than η_Y because the η_Y of C is less than one.

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[11] The farm data were not classified according to N. The observations were adjusted by η_N of .25 to N 3.5 in each Y group.

[12] Several of Houthakker's η_E's are smaller than our η_Y. However, his housing includes fuel-light. Our weighted η_Y for housing and fuel-light is smaller than all of his η_E's.

Although there are a number of studies utilizing Japanese urban and farm survey data, most of them are unrelated to our analysis. The most comparable studies perhaps are those of Yuize [12, 13, 14] which are given in Table 2. The η_Y's in column (b) were estimated by using Y as the explanatory variable from per capita data grouped according to Y. These estimates are similar to our simple regression estimates, except for food. Our estimates are quite different from those in columns (a) and (c) for a few items. The η_N's in column (c) are generally too large; the magnitude of η_E's in columns (a) and (c) does not seem reasonable for some items. Yuize used C as the regressor to obtain η_E's in column (a) from per capita data classified by Y. This is inappropriate, as noted earlier. η_E's and η_N's in column (c) were obtained by using multiple regression with Y and N as regressors from data single classified by Y. As indicated before, the estimates thus obtained may not be reliable.

Table 2. **Demand elasticities for Japanese farm and urban worker households**

	(a) η_E for farm households in 1962	(b) η_Y for urban worker households in 1960	(c) Urban worker households in 1960	
			η_E	η_N
Food	.446	.299	.331	1.096
Rice	.252	.010	−.166	1.737
Vegetables	.322	.354	.671	−.057
Condiments	.196	.199	.221	1.049
Housing	.882	.795	1.333	−.718
Fuel-light	.259	.478	.581	.970
Clothing	1.337	.948	1.316	.215

Sources: Column (a), [13, Table 3.6]; column (b), [12, Table 2]; column (c), [14, Table 2.1].

Trends of income elasticities

In order to discover how the demand for basic living materials changed from 1959 to 1962, the data classified by income were used to estimate the regression coefficients by dummy variables. Assuming that the intercepts are the same but η_Y's are different during the period and taking 1959 as a base[14] (i.e., omitting the dummy variable of that year), the model is

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[13] Of the 35 surveys in his Table II, only two surveys were classified by C. As noted earlier, when C is used as the regressor, data should be classified by C.

[14] Either one of the dummy variables or the over-all constant term must be omitted. Otherwise the parameters cannot be estimated because the matrix of the sum of squares and cross product is singular. It is more convenient to do statistical test by using the method of omitting one dummy variable.

$$\log X_i = a_i + b_{i0} \log Y + \sum_{j=2}^{4} b_{ij} D_j \log Y + W, \tag{3}$$

where W is a disturbance term, and

$$D_j = \begin{cases} 1 & \text{if observation is in the } j\text{th year,} \\ 0 & \text{otherwise.} \end{cases}$$

$j=2$ stands for 1960, 3 for 1961, and 4 for 1962. In (3), the over-all constant term, a_i, is actually the coefficient of the dummy variable omitted. The test of whether the jth year and 1959 have the same η_Y is a t-test.[15]

The results are presented in Table 3, which shows that η_Y of C changes little during the four years. The η_Y for total food decreases during the period except that the η_Y in 1961 is slightly smaller than that in 1960. While the η_Y's for condiments and for cereals as a whole, as well as its individual components, fall over time, those for food items with relatively high η_Y's such as fish, meat-milk-eggs, processed food, cakes-fruits-beverages, and food prepared outside the household increase considerably.

Table 3. Changes of income elasticities in 1960, 1961, and 1962 from the income elasticites in 1959[a]

	Constant	Year				$\bar{R}^2(S)$
		1959	1960	1961	1962	
Total expenditure	1.608	.708	$-.044^f$	$.009^f$	$.021^e$	.984 (.017)
Food	2.419	.499	$-.021^c$	$-.019^c$	$-.025^e$	.979 (.014)
Cereals	2.680	.403	$-.037^b$	$-.073^b$	$-.111^b$	.946 (.017)
Rice	2.266	.462	$-.042^b$	$-.069^b$	$-.100^b$	.952 (.019)
Barley	3.930	.010	$-.042^b$	$-.099^b$	$-.181^b$	.827 (.021)
Other cereals	2.320	.254	$-.029^b$	$-.056^b$	$-.141^b$	.907 (.016)
Vegetables	1.575	.445	$-.001^f$	.076	.069	.971 (.017)
Fish	.506	.645	$.006^f$	$.026^b$	$.048^b$	.981 (.017)
Meat, Milk and Eggs	− .032	.715	$.016^f$	$.072^b$	$.159^b$	.976 (.024)
Processed food	.264	.589	$.003^f$	$.030^b$	$.065^b$	.982 (.016)
Condiments	1.796	.419	$-.019^c$	$-.028^b$	$-.038^b$	.973 (.013)
Cakes, fruits and beverages	.665	.651	$.009^f$	$.042^b$	$.050^b$	.984 (.016)
Food prepared outside household	−1.240	.859	$.023^f$	$.060^d$	$.123^b$	.938 (.045)
Housing	− .099	.852	$.039^e$	$.094^b$	$.111^b$	.952 (.039)
Fuel and light	1.969	.401	$.035^b$	$.070^b$	$.118^b$	.986 (.011)
Clothing	− .539	.916	$.007^f$	$.014^f$	$.026^e$	.986 (.021)

[a] The standard errors of estimates appear in the parentheses to the right of $\bar{R}^2$.
[b] Significantly different from 1959 at better than 1% level.
[c] Significantly different from 1959 at better than 5% level.
[d] Significantly different from 1959 at better than 10% level.
[e] Significantly different from 1959 at better than 20% level.
[f] Difference from 1959 is not significanlty different from zero.

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[15] That is, apply a t-test to see if the estimate of b_{ij} is significantly different from zero.

The η_Y's for housing and fuel-light also increase during the period. The considerable increase in the η_Y for fuel-light over time might result from the availability of more electricity and gas in the rural area and the enlargement of housing space. The η_Y for clothing in 1959 and in the next few years does not differ significantly from zero, although the η_E in 1962 is larger than that in 1959 at the .2 level.

Time-series Analysis

The continuous cross-section surveys through time are very valuable for time-series analysis. In order to overcome the problem of multicollinearity and to obtain estimates consistent with both cross-section and time-series data, the method of combining both kinds of data has been widely employed. Briefly speaking, the method is to insert the η_Y or η_E estimated from cross-section data into the time-series equation. However, the validity of utilizing cross-section estimates jointly with time series is questionable because time-series and cross-section data are influenced by so many different factors.[16] Therefore, the ordinary LS also was used for comparing the estimates with those obtained by the combined technique.

The estimating equations

The "pure" time-series (without restriction) is:[17]

$$q_{ti} = A_i Y_t^{B_i} P_t^{C_{i1}} U_{ti}^{C_{i2}} V_t^{C_{i3}}, \tag{4}$$

where q_{ti} denotes per household demand for the ith commodity in year t; Y_t, per household current real income; P, own price, U_i, the price index of all commodities other than the ith commodity;[18] and V, a price index of related goods. The quantity variable of a given commodity is obtained by deflating expenditure on the commodity by the commodity price index.

Using the logarithmic form and treating quantity as a dependent variable,[19] the conditional regression can be written from (4) as:

$$\log q_{ti} - B_i \log Y_t = \log A_i + C_{i1} \log P_t + C_{i2} \log U_{ti} + C_{i3} \log V_t. \tag{5}$$

Not all the regressors in the equations entered computation at the same time; whenever V was included, U_i was dropped from the equation. One reason for doing so is to conserve degrees of freedom. Another reason is that U_i includes V which introduces multicollinearity if both are used as regressors.

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[16] For a comprehensive discussion of the defects of the combined technique, see [5, 6].

[17] The equations including the preceding year's income were also estimated. However, the preceding year's η_Y's for almost all items are not significantly different from zero.

[18] U_i is converted from the general price index by removing the relative importance of the ith commodity. Thus, for the price index of each commodity, there is an "all other prices" index, which contains prices used in V.

[19] It is argued that whether quantity or price level should be used as a dependent variable in the demand relationship depends on a country's economic condition. Since Japan is not self-sufficient in food, a regression of quantity on price seems more suitable for the demand for food. Although the estimates by using price as a dependent variable can be regarded as "upper limits" to the "true" parameter, most of the elasticities obtained treating price as a dependent variable are so large that they may not be very useful as limits.

Results of the estimation

The estimates of (4) and (5) for seven items are set forth in Table 4. In the conditional regressions, the B_i were taken from the four years' average of the cross-sectional IV estimates. Because of the small number of observations, the Von Neumann-Hart test [2] was applied to test for autocorrelation in an observed sequence of random variables.

Estimation was also done for the equations where permanent income replaced measured income.[20] Although the results are not presented, it is worthwhile to note them. All the η_Y's estimated for various commodities are greater and the standard errors of the estimates smaller whenever permanent income replaced measured income. When both permanent and transitory incomes were used, the results show that, although permanent income is generally superior to transitory income in determining the demand for non-durable goods, transitory income appears more important than permanent income in explaining the demand for such durable goods as housing and clothing.[21] Despite the fact that the simplest method was used to derive permanent income and that a short time series was analyzed, the results appear to support Smith's [9] assertion that, while the permanent income hypothesis is verified with respect to non-durable goods, transitory income is an important variable in explaining the expenditures on durable goods.[22]

Table 4 indicates that:

(1) Except for meat-milk-eggs and fuel-light, the values of $\bar{R}^2$ fall considerably when the pure time-series regressions are replaced by the conditional regressions. This is especially marked for fish and clothing: the $\bar{R}^2$'s fall from very high to nearly zero.

(2) About one-half of the time-series η_Y's are larger than their corresponding cross-section estimates, especially those for meat-milk-eggs and housing. The time-series η_Y's for clothing are less than one-half of the cross-section estimate. One-half of the time-series η_Y's (i.e., for food, cereals, and fuel-light) are not significant at the .05 level, while all the corresponding cross-section η_Y's are significant at the same level.

(3) Only four of the 31 own-price elasticities have the wrong sign.

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[20] An estimate of permanent income is constructed by Friedman's weighted moving average of measured income. For his lengthy discussion, see [1].

[21] The BLS does not consider clothing as a durable good because its normal lifetime is not long enough. In the Japanese income and expenditure survey, clothing is classified as durable good. Houthakker and Taylor [4] regard it as a durable, especially in view of their empirical results.

[22] This is consistent with Friedman's hypothesis, however, since durable goods are not consumed instantly and can be regarded as saving.

P or *C*[b]	Commodity	Constant term	Income elasticity	Price elasticity with respect to				$\bar{R}^2$ (*S*)	Von Neumann-Hart ratio
				Own-price	"All other prices" or related goods' prices				
P	Food	3.50	.505 (.271)[c]	−1.026 (.535)[e]	.646 (.651)[g,h]	—	—	.752 (.020)	.56[i]
					Housing	Fuel & light	Clothing		
P		5.37	.257 (.194)[g]	− .431 (.471)[g]	.467 (.355)[g]	—	−.582 (.250)[e]	.873 (.014)	1.52
C		5.12	.532	− .644 (.473)[g]	.157 (.270)[g]	—	−.483 (.255)[e]	.464 (.015)	1.45
C		4.01	.532	−1.017 (.334)[d]	—	.418 (.140)[d]	—	.445 (.015)	1.23
	Cereals				Fish	Meat, milk, and eggs			
P		6.24	.460 (.410)[g]	− .604 (.537)[g]	− .704 (.482)[f]	—	—	.807 (.032)	1.71
P		7.08	.270 (.279)[g]	− .455 (.469)[g]	—	− .780 (.439)[f]	—	.098 (.031)	1.78
C		6.15	.204	− .348 (.335)[g]	− .456 (.262)[f]	—	—	.325 (.031)	1.64
C		7.01	.204	− .373 (.299)[g]	—	− .716 (.327)[e]	—	.411 (.209)	1.80
P	Fish	− 2.99	.799 (.429)[e]	− .553 (.492)[g]	1.419 (1.520)[g,h]	—	—	.815 (.030)	.96[i]
C		− 2.67	.914	− .540 (.464)[g]	1.086 (.826)[g,h]	—	—	.025 (.028)	1.12[i]
					Meat, milk, and eggs	Condiments			
P		.46	.925 (.284)[d]	.854 (.868)[g]	−1.219 (.861)[f]	− .152 (.560)[g]	—	.822 (.029)	2.11
C		.50	.914	.878 (.515)[f]	−1.231 (.743)[f]	− .158 (.498)[g]	—	.037 (.027)	2.09
P	Meat, milk and eggs	− 6.31	2.439 (.229)[c]	−1.110 (.515)[e]	—	—	—	.932 (.037)	2.24
C		−10.20	1.034	−2.659 (.386)[c]	5.448 (.474)[c,h]	—	—	.931 (.021)	2.88[i]
					Cereals	Fish	Condiments		
P		− 4.88	2.123 (.374)[c]	−2.296 (1.133)[e]	—	1.284 (1.142)[g]	.013 (.737)[g]	.928 (.038)	2.13
P		− 7.32	2.090 (.319)[c]	− .918 (.501)[e]	.793 (.536)[f]	—	—	.940 (.035)	2.18
C		− 5.08	1.034	−3.282 (.522)[c]	1.593 (.214)[c]	2.842 (.385)[c]	−.067 (.357)[g]	.945 (.019)	2.30
C		− 5.18	1.034	−3.308 (.472)[c]	1.602 (.196)[c]	2.826 (.353)[c]	—	.951 (.018)	2.32
P	Housing	−10.28	1.383 (.582)[d]	− .688 (.986)[g]	3.026 (1.859)[f,h]	—	—	.906 (.040)	1.42
C		−10.35	1.329	− .647 (.831)[g]	3.110 (1.531)[c,h]	—	—	.527 (.038)	1.29
					Food	Fuel & light			
P		− 7.42	2.218 (.401)[c]	2.874 (1.136)[d]	− .214 (.893)[g]	−2.830 (.870)[d]	—	.952 (.028)	2.15
C		− 7.62	1.329	3.103 (1.381)[e]	.516 (1.014)[g,h]	−2.075 (.978)[e]	—	.599 (.035)	1.47
P	Fuel and light	.33	.071 (.223)[g]	− .808 (.225)[c]	1.967 (.481)[c]	—	—	.763 (.013)	1.46
C		.75	.554	−1.118 (.207)[c]	1.241 (.411)[d,h]	—	—	.774 (.016)	1.42
					Food	Housing			
P		.79	.297 (.199)[f]	−1.130 (.433)[d]	.967 (.444)[c]	.749 (.565)[g]	—	.737 (.014)	1.39
C		.85	.554	−1.349 (.415)[d]	.756 (.430)[f]	.683 (.586)[g]	—	.807 (.015)	1.47
P	Clothing	− .28	.461 (.331)[f]	− .528 (.271)[e]	1.289 (.642)[e,h]	—	—	.948 (.019)	1.28
					Housing	Food			
P		.29	.502 (.189)[d]	− .587 (.205)[d]	1.086 (.314)[c]	—	—	.968 (.015)	1.43
C		− .91	1.360	− .481 (.364)[g]	− .210 (.237)[g]	—	—	.017 (.026)	1.67
P		.35	.523 (.212)[d]	− .536 (.273)[e]	1.133 (.366)[d]	− .158 (.514)[g]	—	.964 (.016)	1.42
C		− .41	1.360	− .235 (.441)[g]	.188 (.467)[g]	− .808 (.819)[g]	—	.020 (.026)	1.75

[a] Standard errors appear in parentheses to the right of the coefficients, all tests are two-tailed *t*-tests.
[b] Pure time-series equation (*P*) or conditional regression (*C*).
[c] Significantly different from zero at better than the 1 percent level.
[d] Significantly different from zero at better than the 5 percent level.
[e] Significantly different from zero at better than the 10 percent level.
[f] Significantly different from zero at better than the 20 percent level.
[g] Not significantly different from zero.
[h] The price elasticity of a particular commodity with respect to "all other prices."
[i] Evidence of serial correlation at the 5 percent level.

About two-thirds of the elasticities, particularly those for cereals and fish, are not significant at the .05 level. Although all the elasticities with respect to "all other prices" have the positive sign as expected, only one-third of them are significant at the .05 level. Results of the regressions for meat-milk-eggs indicate that both cereals and fish are substitutes to meat-milk-eggs, as one might expect, at the .01 significance level. It seems appropriate that housing and fuel-light are strong complements, as seen in the pure time-series results for housing. Nearly all the other elasticities with respect to related goods prices are insignificant at the .05 level.

(4) Of the 31 equations, four have positive serial correlation at the .05 level. A test of collinearity between income and prices shows that, of the 37 correlation coefficients, only one is positively and 20 are negatively significant at the .05 level. This is probably due to the fact that, although real income increased yearly, the price indexes of basic living material were quite stable or decreased slightly through time.

Concluding Remarks

Using cross-section data, the demand elasticities for various expenditure items were estimated by least-squares and instrumental variables. The least-squares income elasticity may be underestimated since it is substantially smaller than the corresponding instrumental variable estimate, which is a consistent estimate of the parameter. The income and family size elasticities tend to have an inverse relationship; the more "necessary" the good, the larger its family size elasticity.

In time-series analysis the ordinary least-squares and combined technique were used, the latter method with less success than the former. In many cases the income elasticities estimated from the time series were considerably different from the cross-section estimates.[23] Nearly one-half of the time-series elasticities were larger than their corresponding cross-section estimates. Despite the divergence between the income elasticities from cross section and from time series, the order of magnitude of the elasticities resulting from both analyses contained few surprises. The empirical results were consistent with the permanent income hypothesis.

Most of the own-price and all the "all other prices" elasticities carried plausible signs. Two-thirds of the elasticities, however, were not significant at the .05 level. Although nearly all the cross-elasticities with respect to the prices of related goods had the expected signs, most of them were insignificant at the .05 level.

Most of the cross-sectional estimates had magnitudes similar to those obtained by others. Prices are not as important as income in explaining Japanese consumption. The expenditure patterns of the Japanese farm households do not seem to be substantially different from those of the U. S. households.

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[23] For the most detailed explanation of the reasons the estimates differ in the two different approaches, see [6].

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Research Notes[*]

Financial Returns in Agriculture

Don Bostwick

Financial returns in agriculture are estimated in several ways, depending on the purpose of the estimate. When the purpose is to estimate the current financial condition of the farm firm as an operating business, one normally uses the estimated current market value of the resource as the base on which to calculate net worth. When the purpose is to estimate financial returns from proposed new money investments or from changes in past investments, one properly uses the current market value of the new resources in which one proposes to invest as a base on which opportunity rates of a future income stream may be estimated.

However, when the purpose is to estimate the rate of return earned by past money investments in resources of the farm firm, one cannot use current market value as a base. Nor can one use the opportunity cost method for this purpose, since there is no alternative to the investments made and no opportunity to alter them ex post facto.

This note deals with a system for calculating financial returns to past investments and gives an example of returns calculated under alternative assumptions of ownership and equity in the land resource.

Customarily, we state farm earnings as that positive or negative residual resulting from a subtraction of cash and noncash costs of the farming operation from the cash income produced by it. This procedure ignores noncash income that might result from the annual change in the inventory value of land, whereas such changes are included for buildings, stored seed and feed, and machinery and livestock. The annual increments of noncash income will be realized by the land owner when land ownership is transferred and will be taxable income at capital gains rates. This income is a value added to the investment by market appreciation—the obverse of invested money capital that is recovered in annual increments through depreciation.

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[*] See Editors' comments in Communications section.

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The market value of farmland in the United States has been increasing at an average annual rate of more than 8 percent since 1950, but this has not been reflected on the income side of most cost and return studies. Nevertheless, this is a source of income no less real than the growth in market value of industrial stocks—it is a return to the ownership of the land resource.

The general rule for calculating a rate of return on an investment is to divide the quantity earned in a given year by the amount invested. The quantity earned on an investment in farmland might have two components: (1) a noncash return to the investment, estimated by the mortgage rate of interest or some equivalent datum; (2) a noncash return to ownership of the resource, estimated by the annual increment in market value. The sum of these should be divided by the actual investment made—the quantity of money paid out by the owner in trade for his ownership—to obtain a more accurate rate of return.

Another potential source of error in many cost and return studies is the assumption that the typical farmer enjoys full equity in his farming resources. Equity is that portion of the value of a resource not pledged as security for a loan. If risk capital has been advanced by a lender, the financial return to the resource involved is split between the lender and the owner-investor. The former return is carried as a cash cost, the latter as a noncash cost, on the farmer's annual operating statement. There is no reason to suppose that the rate earned by the owner-investor is different from the contractual rate earned by the lender who shares the investment (though not the ownership). The dollars put in as equity capital by the owner-investor, and those put in as risk capital by the lender are identical and indistinguishable. These dollars must earn at the same rate, since there is no magic by which they may be differentiated after they are in the business.

The owner-investor who is heavily leveraged may include, as his, all noncash returns attributable to increased inventory value of the land resource, since he is the sole owner of that resource. He may show very small investment returns on this land resource, since his investment is small in proportion to the total. The heavily leveraged owner-investor will, of course, have a much smaller investment base on which to calculate his rate of return than the full equity owner-investor.

Table 1 illustrates the effect of these points on calculated rates of return. The full equity budget shown is taken from a current report on costs and returns of range beef ranches.[1] It is probably typical of the rancher who bought his resources in 1965 and has zero leverage. The part equity

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[1] The citation is withheld, since it is the purpose of this note to point a finger at the traditional accounting system, not at a particular friend and colleague whose sins are no greater than those of the rest of us.

Table 1. Costs and returns on a cattle ranch

Item	Full equity	Part equity
	dollars	
Investment:		
Land	1,528,837	550,381
Buildings, etc.	55,043	55,043
Machinery	8,491	8,491
Livestock	128,980	128,980
Total investment	1,721,351	742,895
Livestock income (cash)[a]	81,554	81,554
Land value increase (noncash)	—	61,153
Total income	81,554	142,707
Cash costs:[b]		
Operating	28,961	28,961
Interest (mortgage)	—	11,008
Total cash costs	28,961	39,969
Noncash costs:		
Depreciation	5,413	5,413
Operator and family labor	5,000	5,000
Interest on operating costs	1,014	1,014
Interest on investment	—	26,137
Total noncash costs	11,427	37,564
Net cash income[c]	52,593	41,585
Net ranch income	46,166[d]	65,174[e]
Return to capital and management	41,166[f]	72,512
Rate of return on investment[g]	2.39%	13.87%

[a] Income at 1956–1965 average prices.
[b] Prices at 1965 levels.
[c] Gross income less cash costs.
[d] Net cash income less noncash costs.
[e] Net cash income less noncash costs plus noncash income.
[f] Net ranch income less a charge for operator and family labor.
[g] Return to capital and management as a percentage of total investment.

Assumptions for the part equity budget:

1) Land was bought on mortgage in 1955, or 10 years prior to date of study. The current equity is 60 percent, and the mortgage carries a contractual interest rate of 5 percent.
2) There has been an increase in land values averaging 4 percent per year from 1955 to 1965, in the area where these ranch budgets are applicable.

budget shown is typical of the rancher who bought his resources in 1955 and in 1965 is 40 percent leveraged on the land resource.

If one wanted to use these data to calculate opportunity returns on a 1965 ranch land investment, one would start with the current land investment, as given in the full-equity budget, though perhaps with alternative leverage (equity) positions. One would then choose a probable annual rate of change in land value to project a series of budgets, including the capital gains component in returns. If one expects an annual rate of change that is linearly extrapolated on the past 10 years, the budget for 1975 might bear the same relationship to 1965 as the second budget in Table 1 does to the first.

One could complicate the analysis by including net cash returns after taxes each year and net of capital gains taxes when the land investment is liquidated *n* years hence. The after-tax effect would vary in proportion to the taxable income of the owner-investor in this ranch. But the tax shelter aspects of farmland investment and ownership are another story, and a more complicated one.

Financial returns in agriculture might look more competitive with those in other sectors if *all* returns and *all* costs were included in our budget studies. I suggest that very little additional effort would be required in our field studies to gather the data required for budgets like the part equity case above. This would seem to be more representative of financial returns than those we traditionally produce.

Did Futures Trading Influence Potato Prices?*

PETER M. EMERSON AND WILLIAM G. TOMEK

THIS NOTE has two distinct but complementary objectives: (1) to reconsider arguments on the relationship between the volume of trading in Maine potato futures contracts and changes in certain potato prices; (2) to illustrate two known but sometimes disregarded problems in economic research. The reconsideration, we believe, is justified by the numerous criticisms of commodity futures markets. This paper presents additional evidence with respect to an argument presented to the Congress in 1963 [see 4a].

Prior to 1950 there had been little trading in futures contracts for potatoes. In the crop years, 1951–1965, trading in Maine contracts increased substantially, but there was essentially no trading in Idaho contracts. Over the same time period, shipping point prices in Maine declined relative to those in Idaho (Table 1). Testifying before a Congressional subcommittee [4a, pp. 45f], an expert witness stated (a) that the price decline reduced returns to the Maine potato industry roughly $15 million a year, (b) "that futures trading played an important part, if not a dominant part," and (c) that change in "production was not the answer" to the price decline.

Table 1. Volume of trading in Maine potato futures contracts and ratio of Maine and Idaho shipping point prices for potatoes, 1946–1965

Crop years	Five-year averages	
	Trading volume	Maine-Idaho price ratio
	carlots	percent
1946–50	12,392	88
1951–55	105,778	75
1956–60	178,833	70
1961–65	316,783	70

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[*] This paper reports a portion of a larger research project by Emerson [1]; for an earlier, broader analysis see Gray [2]. The authors wish to thank Roger W. Gray for his helpful comments on an earlier draft of this paper; we, of course, take full responsibility for the current content.

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Several price series are available to analyze potato prices in Maine and Idaho, two of which are examined in the following section. Each series leads to a different conclusion about relative price changes and the decline in returns to the Maine potato industry, thus illustrating the problem of data selection relative to a research objective. An analysis of Maine and Idaho potato prices for the crop years 1951–1965 (presented later in this discussion) suggests that, contrary to the testimony cited, changes in production do largely explain price variation through time. Furthermore, the net effect of futures trading on Maine prices, if any, appears to be positive, not negative. This illustrates that the net relationship, other variables taken into account, may differ from simple two variable relations and, hence, that reasoning from simple correlations can be fallacious.

Alternate Price Series

As with any commodity, there is no such thing as "the" price of potatoes. Shipping point prices were used in the critique presented to the Congress. These are prices at certain representative points in Maine and Idaho for U.S. No. 1 size A potatoes sold primarily for fresh (tablestock) purposes. Another, frequently used series is the season average price received by farmers, as reported by the Statistical Reporting Service (SRS) of the USDA, which measures average prices for sales for all purposes. These two price series for Maine and Idaho are summarized in Table 2.

Table 2. Shipping point and SRS season average prices for potatoes, Maine and Idaho, 1946–1965

Crop years	Five-year averages					
	Shipping point prices[a]			SRS season average prices[b]		
	Maine	Idaho	Ratio	Maine	Idaho	Ratio
	dollars per cwt		percent	dollars per cwt		percent
1946–50	2.40	2.73	88	1.94	1.74	111
1951–55	2.41	3.20	75	1.97	1.80	109
1956–60	1.89	2.70	70	1.63	1.52	107
1961–65	2.30	3.29	70	2.09	1.85	113

[a] U.S. No. 1, size A potatoes, mostly Katahdins in Maine and Russet Burbanks in Idaho.

[b] Weighted average price for all sales as reported by Statistical Reporting Service, USDA.

Relative prices as measured by the two series obviously have performed differently over the 1946–1965 period. The shipping point price series suggests that Maine prices have declined relative to Idaho prices; the SRS average price series suggests that they have not.

The explanation for the different conclusions lies in the definition of the two price measures. The SRS series is an average for all sales, both processing and fresh. Processing prices are usually somewhat below fresh use prices. In Idaho a relatively high and growing percent of the crop is sold for processing, whereas in Maine the emphasis is on tablestock sales. Thus, the average price for all sales is higher in Maine than in Idaho, and with the trend toward processing sales in Idaho, average prices in Maine have remained strong relative to those in Idaho.

Shipping point prices reflect mainly prices received by growers for sales in the fresh market. Idaho potatoes normally command a premium over Maine potatoes in the fresh market, which is reflected in this price series. The evidence also suggests that Maine shipping point prices did decline relative to those in Idaho, at least from the late 1940's until about 1961 or 1962.[1]

The analyst may legitimately wish to consider the influence of the volume of trading of futures contracts on the price of potatoes sold in the fresh market (i.e., shipping point prices). However, the correct measure of total revenue is total sales multiplied by the average price for all sales. Since this average has not declined either absolutely or relatively for Maine prices, it is difficult to conclude that the Maine potato industry is losing 15 million dollars a year because of trading in potato futures.

A Regression Analysis of Potato Prices

Specification of equations

Multiple regression analysis is used to estimate the net influence of certain variables on Maine and Idaho shipping point prices. The equations estimated specify price as a function of certain production and demand variables. The production variables measure local (state) production and production in the rest of the United States. Price and the production variables are expected, of course, to be inversely related.

Variables to capture shifting regional demands are more difficult to specify. Income is a typical demand shifter, but it is difficult to anticipate whether the coefficient would be negative or positive [see 3]. A linear trend variable also might be used to capture systematic shifts in demand, but trend is purely a proxy for other variables that may be influencing price. Population is taken into account by putting the variables on a per capita basis.

If the demand for Idaho potatoes for tablestock use is growing faster or declining slower than for Maine potatoes, as seems logical [1, pp.

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[1] Idaho prices were significantly higher (by a *t*-test) than Maine prices for the crop years, 1946–1965. The ratio of Idaho to Maine prices, by 5-year periods, is given in Table 1. The absolute, average differences in prices for the same periods are 33, 79, 81, and 99 cents, respectively.

106–108], then the variables designed to capture shifts in demand would have larger positive or smaller negative coefficients in the Idaho equations.

The dependent variable for the Maine equations is the annual average shipping point prices (in Maine) per hundredweight for U.S. No. 1, size A Katahdins; for the Idaho equations, it is the annual average shipping point prices (in Idaho) per hundredweight for U.S. No. 1, size A Russet Burbanks. These prices are identical with those used in the 1963 testimony [4a] and hence permit direct appraisal of that testimony.

The independent variables include:
X_1 = Maine production, pounds per capita;
X_2 = Idaho production, pounds per capita;
X_3 = U.S. minus Maine production, pounds per capita;
X_4 = U.S. minus Idaho production, pounds per capita;
X_5 = personal disposable income in U.S. dollars per capita; and
X_6 = linear trend $(1, 2, \ldots, 15)$.

The estimates are based on 15 annual observations for the crop years 1951–1965.[2] The equations are linear in the observations. The coefficients are estimated by the method of least squares.

Results

Two equations for each state, which summarize the analysis, are presented in Table 3.[3] The table includes estimates of the regression coefficients, their standard errors, the Durbin-Watson statistic (d), the coefficient of multiple determination adjusted for degrees of freedom ($\bar{R}^2$), and the price flexibility coefficients.

Variation in prices in both states is clearly related to changes in per capita production, both locally and in other areas. Maine has a larger own-price flexibility coefficient than Idaho. Thus, a given percentage change in production in Maine has a larger influence on Maine price than the comparable change in Idaho.

Over the 15 years, 1951–1965, Idaho production per capita has trended upward, while Maine production per capita has shown no trend. Hence, the net effect of local production has been to depress Idaho prices. Maine prices, on the other hand, have fluctuated from year to year in response to

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[2] The analysis begins with the 1951 crop year to avoid the price support period. The change in relative prices in the 1951–1965 period, however, was fairly small (see Table 2). This emphasizes Gray's point [2] that the removal of price supports was an important factor in the relative price change from the late 1940's to the early 1950's.

[3] These results are only a part of the equations estimated. Other geographic and seasonal breakdowns of production and other measures of demand changes were considered [see 1].

Table 3. Estimated regression equations for shipping point prices, Maine and Idaho potatoes, 1951–1965

Maine equations	Inter-cept	Independent variable[a]				$\bar{R}^2$	d	Price Flexibility[b]
		X_1	X_3	X_5	X_6			
1	12.001	−.166 (.068)	−.080 (.015)	.002 (.0008)		.71	2.05	−1.54
2	14.829	−.160 (.073)	−.081 (.016)		.052[c] (.032)	.66	1.79	−1.48
Idaho equations		Independent variable						
		X_2	X_4	X_5	X_6			
1	16.427	−.100 (.072)	−.129 (.041)	.002[c] (.002)		.73	2.39	− .74
2	19.599	−.126 (.090)	−.122 (.044)		.110[c] (.102)	.73	2.25	− .94

[a] See text for definition of variables and statistics.

[b] Price flexibility is computed at mean level of the dependent variable and X_1 or X_2.

[c] Coefficients not statistically different from zero at the 10 percent level of significance, using a one-tail test except for X_5 and X_6.

local production changes, but the overall effect has not been a downward trend.

The variables measuring external production (X_3 and X_4) are also important "explainers" of local prices. Partial r^2 coefficients for X_3 and X_4 are about twice those for X_1 and X_2. Price flexibility coefficients computed at the means indicate that a one percent change in producion outside the state results in a 4.5 percent change (in the opposite direction) in the state price, both for Maine and Idaho.

Over the 15 years, 1951–1965, per capita production outside of Idaho has remained about constant, while per capita production outside of Maine has increased. External production apparently has had no trend effect on Idaho prices but has resulted in a decline in Maine prices. In other words, a factor in the relative decline in Maine shipping point prices is the increase in production elsewhere.

The signs of the income and trend coefficients suggest that prices and "demand shifters" are positively related (net of the price-production relationships). In other words, after adjusting for changes in per capita production, the trend in prices is positive, whether measured by income or linear trend. However, the coefficients for these variables tend not to be statistically different from zero. There is some evidence[4] that the net positive changes in Idaho prices are larger for Maine. Hence, the influence of these variables, if any, is to cause a somewhat faster positive growth in Idaho prices. This, of course, is consistent with the idea of a relative decline in Maine prices.

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[4] The trend coefficient in the Idaho equation is larger than that in the Maine equation. This plus estimates of coefficients of "demand shifters" in equations not presented in this paper are the basis of the evidence.

Incidentally, the pure empiricism of the analysis presented to the Congress can be carried one step further. It was based on the inverse correlation between volume of futures trading and relative price changes. The trend or income variables also have a simple inverse correlation with relative prices. The net relationship of trend and income with the price variables is positive. This suggests that if the volume of futures trading were used as a proxy for trend, the coefficient would be positive in the multiple regressions. Thus, carrying the empiricism to its logical conclusion, we could argue that the increased volume of futures trading "caused" higher potato prices in Maine, net of the influence of production.[5]

The results of the regression analysis are consistent with and lend support to two arguments by Gray [see 2 and 4b, pp. 58f]. He first emphasized the relatively greater impact of the price support program on Maine. It follows that the removal of the program is likely to have had a larger effect on Maine prices. The regressions indicate that a given change in local production has a greater influence on Maine price than on Idaho price. This suggests that Maine prices were more sensitive to a given transfer of production from government purchases to regular commercial channels.

Gray's analysis also indicates [4b, p. 67] that "buyers of (Maine) futures contracts have characteristically paid too high a price, representing excess demand for long positions in the futures market." Speculators were net losers [4b, p. 65], and hedgers, who are typically short, were the beneficiaries. Our analysis suggests that the net influence, if any, of futures trading on Maine prices would be positive.

In sum, changes in shipping point prices for potatoes in the 1951–1965 period are mainly related to changes in per capita production. This is in direct contrast to certain congressional testimony. The influence of "demand shifters" is apparently small but positive.

References

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[5] Let X_7 = annual volume of trading in Maine potato futures in carlots (see Table I for average levels); then the estimated regression for Maine potatoes is

$$Y = 12.956 - \underset{(.065)}{.150X_1} - \underset{(.014)}{.067X_3} + \underset{(.000001)}{.000002X_7}, \text{ and } \bar{R}^2 = .74.$$

The coefficient for X_7 is small because the observations on X_7 are large relative to the price of potatoes. The *t*-ratio for this coefficient is 2.57; thus, the volume of trading variable has a statistically significant positive coefficient. The coefficient for X_7 retains its sign and magnitude even when X_5 and X_6 (income and trend) are added to the equation.

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[3] HEE, OLMAN, *Demand and Price Analysis for Potatoes,* USDA Tech. Bul. 1380, July 1967.

[4] U.S. Congress, 88th, first session, "Irish Potato Futures Trading," *Hearing before a Subcommittee of the Committee on Agriculture and Forestry United States Senate on* S. 332, September 30, 1963.
   a. Testimony of Douglas B. Bagnell on behalf of the Maine Potato Council, pp. 43–54.
   b. Statement of Roger W. Gray, Professor, Food Research Institute, Stanford University, pp. 58–88.

More on the Aggregation Problem: Some Suggestions

RICHARD H. DAY

MY ANALYSIS of the aggregation problem involved in developing linear programming models of representative farms [1] has received some attention—probably more than it deserves, in view of the rather discouraging implications it holds for the number of firms required for exact aggregation.[1] On the other hand, my suggestions [2] for circumventing the theoretical difficulties and practical costliness of the representative farm approach seem to have been overlooked. I therefore would like to take this opportunity to bring these suggestions to the attention of the readers of this journal, especially in the light of Marenco's and my respective reconsideration of the problem [this issue]. Specifically, I would like to suggest research in (1) the mathematical and behavioral analysis of "management leadership" and (2) development of research aids that would lower the cost of building and testing relatively large numbers of representative firm aggregate models.[2]

Management Leadership, Imitation, and the Number of Representative Firm Aggregates

In spite of the aggregation problem, there is indeed some evidence that at least crude aggregative fits can be obtained for agricultural data by the use of a single linear programming model for subaggregates, including all the farms in several counties, and of all ranges in size and resource variation [3]. This evidence led me to suggest that imitation of prominent producers' decisions by surrounding firms may lead to a considerable degree of proportional variation in farm *activities*, more than the l.p. behavior based on wide technical dissimilarities would predict. The idea is that individual farmers in a given small area tend to imitate "management leaders" or prominent producers and, as a consequence, behave as if they were much more homogeneous in input-output and resource structure than they really are.

Such behavior might have a well-defined basis in the theory of rational choice. This is because a decision maker who recognized his own limitations might, for quite rational reasons, imitate a neighbor in whose man-

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[1] Cf. my comment on Marenco's paper, this issue.

[2] Terminology has never been standardized. I use the term "representative firm aggregate" to mean an aggregate of resources belonging to many different firms whose allocation is represented by a single microeconomic model of firms' decision making.

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agerial ability he had greater confidence than in his own. In other words, he might make more money by doing a good job of applying another firm's solution than he would by attempting to find a solution optimal for his own technical conditions, simply because he is a good imitator but a poor optimizer.

There are at least two reasons why imitation of this kind would be distributed over time. First, it probably takes some time for a producer of modest managerial ability to be convinced of the improved efficiency of a neighbor's decision, and some decision makers will take longer to be convinced than others. Second, there is probably a conservative streak in many decision makers that leads them to be exceedingly cautious in departing from past decisions that have "worked." They tend to identify change with risk.

"Flexibility constraints" or "behavioral bounds" on individual activities or groups of activities are introduced into linear programming models to accommodate these two hypotheses. They allow for asymptotic convergence over time to the aggregate results that would be predicted without them. The l.p. model *without* flexibility constraints would be regarded as a solution that would be obtained under perfect certainty and by an aggregate of rational, consciously maximizing entrepreneurs, while the model *with* flexibility constraints gives the solution for an aggregate whose members move towards this hypothetical target at varying rates of speed.

There are other ways of modeling management leadership and imitation, and I would urge those wishing to contribute to the art of operational quantitative model building to push into this area.

Reducing the Cost of Model Building

The practical conclusion of the preceding remarks is that behavioral friction and imitation will justify the use of many fewer representative firm aggregates than would seem to be required from the parametric programming arguments. Even so, the number of subaggregates will be large, numbering at least in the hundreds for a country the size of the United States. Consequently, the microeconomic model building will be costly even when based on representative firm aggregates numbering a tiny fraction of the total number of firms whose aggregate behavior is of interest.

There is a limit to which modeling costs can be reduced by appeal to imitation, behavioral constraints, and the like. I would like to promote two means for further reducing at least the economist's part of these costs. First, I would like to see a comprehensive, living encyclopedia of agricultural technology and farm practices developed. This would provide economists (and other scientists) with a comprehensive and up-to-date source of basic input-output data from engineering sources, manufacturers' specifications, and sample survey data. A first edition could be compiled by carefully editing existing engineering journals, manufacturers' advertisements, and published survey results. It could be augmented with annual supplements, describing the latest innovations, and improved estimates of old technologies and practices, obtained from new surveys.

Second, I would like to propose the development of a data retrieval system for county agricultural data collected by the U.S.D.A. that would make aggregation and graphing of arbitrary commodities for arbitrary geographical aggregates over time inexpensive and timely. By informally and statistically comparing time paths of variables for alternative geographical aggregates, regions could be identified that exhibit similar behavior. This would help provide a guide to defining regional strata for representative firm analysis. A pilot system of this kind has been developed at the Social Systems Research Institute [4] and is now being extended.

Conclusions

Maximizing models modified to represent management leadership and imitation may be able to represent the behavior of much larger groups of firms than would seem to be suggested by an analysis of technical input-output coefficients and resource distribution. This hypothesis—if true—reduces the cost of model building by reducing the number of models that need to be built.

Even so, the number of representative firm subaggregates required for large agricultural regions will be quite large, and aids to reduce the cost of model building are clearly desirable. Two are suggested: (1) an annually updated encyclopedia of agricultural technology and farm practices and (2) a computer storage, retrieval, aggregation, and graphical display system. The former would reduce the cost of assembling input-output coefficients for large scale models. The latter would provide a means for establishing regional areas with similar commodity histories and hence with similar technical and behavioral structures.

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Effect of a Health Hazard "Scare" on Consumer Demand[*]

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THE possibility of pesticide residue contaminations has become public knowledge in recent years. Such possible health hazards are new phenomena affecting the marketing of food. For example, when the Secretary of Health, Education, and Welfare announced on November 9, 1959, that cranberries may contain residues of a herbicide known as amino triazole, a major health hazard "scare" developed. This announcement received much consumer attention, and producers felt that the sale of cranberries from unsprayed bogs was hurt as a result [1]. Satisfactory documentation of the economic effects of this announcement is lacking, however.

This paper examines weekly household consumption of cranberries before (1957–58), during (1959), and after (1960–62) this pesticide "scare." Data were obtained from a panel of approximately 300 families in Atlanta, Georgia, who reported weekly food purchases for six years from 1957 through 1962. The analysis was based on weekly observations from households that purchased fresh and/or processed cranberries during the fourth quarter of each year.

The hypothesis is that consumer knowledge of possible pesticide contamination of cranberries would increase the price elasticity of demand. This hypothesis is based on two assumptions: (1) that the price elasticity of cranberries is similar to that of all fruit, and (2) that consumer knowledge of possible pesticide contamination may have the opposite effect of advertising on price elasticity.

Advertising tends to reduce the substitutability of a product through product differentiation. Advertising may also encourage more emotional buying and effort to consider substitutes [4]. Furthermore, ". . . advertisement may not only convince the new buyers that they should buy the product, but it may also convince the old buyers that the product is so good that they should not give up buying the same amount at much higher prices" [3]. Thus, advertising may decrease the price elasticity of demand. Conversely, known product contamination, or adverse advertising, may increase the elasticity.

Method

Variation in per capita purchases (Y) of fresh cranberries (pounds) and processed cranberries (ounces) was postulated to be dependent on

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[*] Journal Series Paper No. 315, Georgia Agricultural Experiment Station.

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variation in the following independent variables, by week, during the fourth quarter of each year, 1957 through 1962:

$$Y = f(X_1, X_2, X_3)$$

where

X_1 = average price (cents per unit of weight),
X_2 = age of homemaker (1 = under 30, 2 = 31-45, 3 = 46-60, and 4 = over 60), and
X_3 = per capita income (dollars).

Thus, the derived demand elasticities are adjusted for the effects of age and income.

Linear and logarithmic least-squares equations were computed. The choice of the model was based upon the size of the coefficient of determination and the number of significant coefficients. Under these restrictions, the linear model was chosen for processed cranberries. Fresh cranberries were omitted from the analysis because the price coefficient was significant ($p \leq 0.05$) for only two of the six years.

Results

Forty-six percent of the households purchased processed cranberries during 1957-58 and 1960-62; 33 percent, in 1959. Per capita purchases of processed cranberries dropped 26 percent during 1959, compared with 1957–58, but regained the 1957–58 level during 1960–62. Retail prices, on the average, remained fairly constant.

Based on the linear regression equations for each year, the homemaker's age was positively ($p \leq 0.05$) related to per capita purchases of processed cranberries. Income was also positively ($p \leq 0.01$) related to per capita purchases, except during 1961. The quantity-price coefficient was significant ($p \leq 0.01$) in each of the six years. The demand elasticities for processed cranberries, computed at the mean values of these independent variables, were as follows:

1957, $\varepsilon = -0.87$	1960, $\varepsilon = -1.16$
1958, $\varepsilon = -0.93$	1961, $\varepsilon = -0.88$
1959, $\varepsilon = -0.93$	1962, $\varepsilon = -0.77$

To test the hypothesis of difference in these demand elasticities, an equation was estimated for the combined six years to test if one regression can be used for all observations, as follows:

$$\begin{aligned} Y = 7.754 &- \underset{(0.4166)}{4.5672X_1} + \underset{(0.1840)}{1.7631X_2} + \underset{(0.0001)}{0.0012X_3} \\ N = 1419 & \qquad R^2 = 0.203 \end{aligned}$$

Based on the computed F value, no significant differences existed among the six years. Thus, no statistical evidence exists to support the hypothesis of an increase in demand elasticity following a period of public knowledge of possible pesticide contamination.

The observations for 1959 and 1960 and for 1961 and 1962 were paired, since no significant difference existed between the regressions for each year within these two pairings. It was postulated that the observed decrease in demand elasticity from 1959–60 to 1961–62 was significant and might possibly be due to the increased advertising expenditures that occurred, at least in part, for the industry.[1] Following the same testing procedure used for the hypothesis of increased elasticity, it was found that no significant difference existed between the two regressions for the two periods. Thus, no statistical evidence exists to support this supposition about advertising expenditures.

Implications

The Food and Drug Administration has issued assurances about the safety of our food from pesticides. Their studies indicate residues "... are substantially below the limits set for acceptable daily intake by the World Health Organization and United Nations Committees" [2]. This record, however, does not prevent the occurrence of incidents similar to the 1959 cranberry pesticide "scare."

The 1959 incident appeared not to have had any significant affect on the elasticity of demand for processed cranberries among households in Atlanta, Georgia. The only apparent effects were temporary declines in the number of households purchasing processed cranberries and in per capita purchases among purchasing households. Advertising may be an effective tool to offset in part a change in demand elasticity resulting from a pesticide residue incident. This area warrants further research, particularly identification of socio-economic sub-groups who react either positively or negatively to various forms of advertising in relation to their levels of purchasing.

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[1] Personal letter from Edward Gelsthorpe, President, Ocean Spray Cranberries, Inc., March 19, 1968.

EDITOR'S NOTE: This section of the *American Journal of Agricultural Economics* may include comments on and replies to previous articles and other literature in agricultural economics, suggestions for improving the effectiveness of the AAEA, discussions of changes in emphasis needed within the profession, and contributions on other topics of interest and importance to agricultural economists. Manuscripts submitted for this section should be prepared in accordance with the guide appearing on the inside of the back cover of this issue and should not exceed 1,000 words.

Communications

ECONOMETRICIANS AND THE DATA GAP: REPLY—COMMENT

Surely, most of us read this Journal for the best reasons—to see the results of research in areas other than our own and to learn of newly developed analytical tools or fresh applications of proven tools, thus keeping up with happenings in the profession; or perhaps just to learn from the free flow of critical ideas concerning each other's research efforts. For the interested but uninitiated, professional controversies can offer special opportunities for gaining insight into current problems. Such was my hope when reading the comments of Grove regarding the data gap and econometricians.

However, I must confess that I failed to find adequate reply from Scott and Heady to the major complaints of Grove. Let me be clear that I do not wish to enter into this debate as a participant, but as an observer interested in learning and in testing my assumed knowledge of the subject matter.

Grove's major observations seemed to be:

(1) That too many econometricians, especially the aspirant, have low quality thresholds when it comes to their model input data.

(2) That an example of this is found in the Scott-Heady study referred to, because

(a) data used legitimately to calculate certain depreciation values, and which were then allocated in a legitimate manner, were *conceptually* misused to generate input for the Scott-Heady model, and

(b) in the process of obtaining "satisfactory" results from the model, Scott and Heady violated a basic research principle—that of not fishing *a posteriori* for significant variables.

(3) That too many econometricians are unwilling to forsake quantity for quality in their model building.

The reader may wish to agree or disagree with the first and third complaints, which, after all, are generalizations. However, Scott and Heady might conceivably retort successfully to these charges and yet be guilty of complaint (2).

Their reply to (a) suggests a contest of professional credentials, both personal and with members of ERS. The reader is then referred to their Bulletin 545 for additional findings that presumably will clarify this whole matter. Grove's complaint (b) is turned against him in the form of a least-cost justification. However, it seems to me that if the complaint is correct, there could be no justification, even if resources for the model were *free*. Finally, it appears that Scott and Heady admit their data is erroneous (whether in accuracy or as used is not clear) but divert the reader's attention through the device of an irrelevant dilemma.

The reply may be personally gratifying to its authors, but it is not very satisfying to a reader who hopes to learn from the exchange between assumedly qualified individuals. Up to now, the exchange has been less than straightforward and, consequently, disappointing.

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A WATER RESOURCE ECONOMIST LOOKS BACK AT A LAWYER

We stand condemned of failure to "eliminate legal constraints" to optimal utilization of water resources [3]. Although I am not sure whether most economists would feel insulted by or proud of this condemnation, I do believe that Levi has presented only a cursory view of the activities and motivations of many water resource economists. As a lawyer, he apparently has led a sheltered life, sheltered not only from the interdisciplinary realities of law making, but also from the supposedly objectionable[1] presence of an economist at every turn.

In the process of developing his condemnation, Levi makes the following observations, to which I shall respond in turn.

1. *Legal constraints on allocation make possible letter-perfect case studies, which can ultimately result in the creation of policy.*—The mere fact that an economist must deal with a common property resource and the associated tendencies for all forms of technological and pecuniary externalities, to say nothing of the ever-present necessity of struggling with the problem of interpersonal utility comparisons and the social welfare issues that are always present in an evaluation of water use alternatives, removes these studies from the "letter-perfect" category. What Levi is suggesting is that we can take these elements, along with the many facets of production and demand, label it all *ceteris paribus* and proceed to evaluate the isolated effects of certain legal constraints.

Assuming the existence of usable data, the quantification of these constraints still remains a herculean task, even with a host of simplifying assumptions. Without this data and the questionable legitimacy of the assumptions, the task facing a researcher of this common property resource may be more appropriately labelled hopeless than letter-perfect. To further compound this problem, all one needs to do is to ask two different lawyers for an opinion on a single legal point.

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[1] To some administrators and lawmakers.

2. *Water resource economists have the opportunity to help shape society's future by developing new systems of water law based on economic theory.* —An economist making such a statement would be attacked as exceedingly naive. Indeed, there are presently several debates on the procedures used in certain aspects of water resource analysis, such as (1) measuring the demand for recreation, (2) the measurement of consumer surplus, (3) the quantification of externalities, (4) the appropriateness of micro-regional input-output models, (5) the adjustment of discount rates in benefit/cost analysis, and (6) the inclusion of regional secondary benefits.

There is no doubt that, in facing these problems, economists may be able to help shape society's future. However, it will not be by developing new systems of water law based on economic theory. There would be general agreement that economists must recognize institutional constraints in model building, especially if these constraints play a dominant role. We must therefore subsequently so phrase our conclusions that they may be of value to members of every associated discipline. Further, I agree with Levi's personal opinion that economists should be aggressive in communicating with lawyers, but I would add an equal responsibility for lawyers to seek out new knowledge from all disciplines related to the modification of old or the initiation of new precedent in water law.

The essential point here is that nothing is based on economic theory alone. Water resources especially represent an interdisciplinary management problem. Decisions must be based on a combination of technical, economic, social, and political considerations. If lawyers can specify those items of economic information they need, economists will respond, although this may be accompanied by a lecture on interpersonal comparisons and equity considerations.

3. *A review of the literature supports this.*—As Levi suggests, *selecting the proper forum* is crucial in communicating results of economic analysis to legislators (lawyers). He also suggests, and I agree, that journal articles are not appropriate as they are seldom read (or understood) by the right people. I am puzzled how, in light of these statements, he can then conclude that economists are failing to communicate by reviewing "the literature." They may in fact be using other, more direct channels to communicate information that is of value to legislators. The publish or perish syndrome has on the whole been admirably by-passed.

The legislative impact of the discussions at the turn of the decade cannot be truly measured. We can, however, look to the increasing role played by the water resource economists in the Natural Resource Economics Division of ERS, USDA, the Corps of Engineers, the Soil Conservation Service, the Water Resources Council, the Office of Water Resources Research, the Federal Water Pollution Control Administration, and numerous other Federal, State and regional bodies. Literally hundreds of economists in these agencies are directing their efforts toward the planning, development, and administration of water resources. For many of these men, their ultimate achievement is to see the fruits of their work published in the *Federal Register* or some equivalent state organ.

Levi would approve of this motivation, I am sure, yet he is apparently unaware of this group of economists, who certainly predominate among the total of all water resource economists, if only by their numbers alone. Even in academic circles, economists like Castle, Crutchfield, Wantrup, and Gardner have communicated quite successfully with lawyers such as Johnson, Trelease, Sato, and men in administrative positions ranging from Federal to local.

4. *Economists should turn their creative talents to developing innovative legislative mechanisms that approximate the results of the purely competitive market system and are palatable to legislators and other policy makers.* —The key word here is the adjective *legislative*. Economists have long been intrigued with mechanisms (viz., their interests in regional compacts, bribes, and charges, etc.). I submit however, that legislative mechanisms represent an area of mystique more germane to the political scientist or the practicing politician. It would be inefficient use of time and talents for an economist to try to operate as an amateur in this medium.

The appropriate sequence would include an exchange, in the legislator's language, between the economist and the legislator, including the essential recommendations for change. The legislator will then suggest what he believes to be the appropriate legislative mechanism. The economist may review these to ascertain whether they are capable of attaining the desired results. These suggestions will then be forwarded through the political process. At any point in this sequence, the concepts and/or their representative mechanism may be rejected. Once this has occurred, the economist can pursue the matter further only as a citizen crusader. In making this observation I am merely acknowledging that to be an economist one must pursue the science (art?) of economics. We can no more become lawyers and legislative mechanics to create the laws to regulate pollution than we can become the architects and engineers who design and build the treatment plants.[2] Although it may not be necessary to publish in order to avoid perishing as economists, it is necessary to limit one's activities if one is to avoid becoming a "jack of all trades, master of none." Those who have broadened their activities to the detriment of their economic "sophistication" are well aware of the professional degradation and often the financial sacrifice that may result.

5. *Eliminating this constraint will permit a movement toward the optimal point of production.*—Levi may be more appreciative of the difficulties involved when the errors in this statement are indicated.[3] First is the

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[2] Further discussion on the role of the economist may be found in [1] and [2]. Levi's basic point seems to be an extension of what Breimyer labelled as one of the products of agricultural economics, "guidelines to the making of public policy" [1, p. 343]. If Castle has some objections to Breimyer [2, p. 813], I assume he will react quite strongly to Levi.

[3] The comments under this point were enhanced by a discussion with Frederick V. Waugh.

exclusive focusing on a firm while at the same time concluding that an increased benefit will result from *our water resources.*

At issue here is private versus public optimization. Removing a law that prohibits the disposal of effluent into a stream may allow a firm generating effluent to minimize cost while increasing both production and profits. From the firm's individual point of view, the absence of such a law creates optimum conditions. However, for many downstream users who need water of a certain quality for economic *and* social purposes, removal of this protective law may also remove a precondition to their optimal use of *our* resources.

In another example, a groundwater user may benefit from the cancellation of a restriction on withdrawal rates. As this resource is shared by others, this near term activity may have detrimental effects on productivity of all firms at some time in the future when the supply is depleted. In this example, even the individual firm in question may not be maximizing its discounted stream of earnings in the absence of the regulation on withdrawal rates.

Even with these considerations of the individual concern versus the public and the near term as opposed to the long run, we still have not faced the issues of equity and income redistribution. With all of these contingencies, it should be obvious that the elimination of a legal rule will permit true optimization only within a specific set of circumstances. With this in mind, it would be foolhardy to suggest that "they [economists] should reorient their research efforts and adopt as their mission not only the identification, but also the complete elimination of all legal constraints."

Concluding Comments

Despite the above comments, I find myself sympathetic to Levi's plea to water resource economists to become more aggressive in seeking the revision of the legal structure of water law based on the findings of economic analysis. However, his flattering but rather naive overstatements of the potential in this area does a disservice to economists, lawyers, legislators, and administrators who are diligently struggling with the manifold aspects of the problem. They should not be discredited because they have not (a) eliminated legal constraints and therefore optimized production, (b) developed new systems of water law based on economic theory and assisted by letter-perfect case studies, (c) developed appropriate legislative mechanisms, and (d) presented all this in lay terminology to lawyers, administrators, etc., while at the same time miraculously forcing these same lay writings into "the literature."

Given that the explicit statement of certain water laws permits a more effective venture into institutional economics, this may explain why in fact this is one area in economics where more planning, problem-oriented research is being conducted at all levels. Condemnation by certain economists who advocate more "sophisticated, basic" research is one matter, but criticism from lawyers at the other extreme could be unjustifiably demoralizing if left unchallenged.

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EXACT AGGREGATION WITH LINEAR PROGRAMMING MODELS—A NOTE ON THE SUFFICIENT CONDITIONS PROPOSED BY R. H. DAY

Richard H. Day's 1963 article [1] on exact aggregation in linear programming models has now become an obligatory reference for research workers in the field of aggregate linear programming. Day presented sufficient conditions for using—without loss of precision—a single aggregate model to define the optimum combination of productive activities for a group of firms, rather than separate models for each firm.[1]

The aim of this note is to show how at least one of these conditions—required particularly for obtaining from the aggregate models unbiased results for the unknowns of the dual problem—is not necessary. More precisely, the condition in question is not an additional condition with respect to those remaining, in that it is always respected if the others are already respected. From a certain point of view, one can therefore say that the modification proposed here to Day's results is only formal. However, in addition to constituting a conceptual clarification, this modification could also have practical relevance for those who wish to make use of the conditions of Day in an empirical research work, thereby avoiding the useless control of a condition that necessarily holds.

Briefly, the results of Day may be summarized as follows (we will use, for the most part, the symbols adopted by him):

Let us assume a group of firms, for each of which can be solved a problem of choice of the optimum combination of productive activities in terms of linear programming.

For enterprise i the problem may be formulated as follows:

To maximize

$$\pi_i = z_i' x_i$$

subject to

$$B_i x_i \leq c_i$$

The corresponding dual may be formulated thus:

To minimize

$$\rho_i = c_i' r_i$$

subject to

$$B_i' r_i \geq z_i$$

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[1] More recently, Thomas A. Miller [2] showed that conditions less restrictive than those proposed by Day are sufficient to ensure equality between the solution of the aggregate model and the sum of the solutions of the single models. However, the conditions of Day, unlike those of Miller, also ensure proportionality between the vectors of the aggregate and the individual solutions; this allows considering of the proportions between the levels of different productive activities that are derived from the solution of the aggregate model as optimum proportions between the levels of the same processes for each firm of the group.

The same problem, formulated for the aggregate of the firms of the group will be:

To minimize

$$\pi = z'x$$

subject to

$$Bx \leq c$$

and the dual:

To minimize

$$\rho = c'r$$

subject to

$$B'r \geq z$$

in which

$$c = \sum_i c_i \qquad (1)$$

and

$$z = \sum_i \alpha_i z_i \qquad (2)$$

Let us indicate by x_i^* and r_i^* the vectors of the solutions of the primary and dual problems of the i-th firms and by x^* and r^* the corresponding solutions of the aggregate problem. Sufficient conditions for ensuring that the results of the aggregate problem are not biased, that is, in order to obtain

$$X^* = \sum_i x_i^* \quad \text{and} \quad r^* = \sum_i \alpha_i r_i \qquad (3)$$

are, according to Day [1, p. 802]:

$$B_i = B_j = B \qquad (4)$$

$$c_i = \lambda_i c \qquad (5)$$

$$z_i = \gamma_i z \qquad (6)$$

$$\sum_i \alpha_i \gamma_i = 1 \qquad (7)$$

The last condition, in particular, is required so that the second of the equalities (3) can be verified; it would not be necessary if one wished to consider exclusively the results of the primary problem.

Our observation concerns specifically this last condition. In our view, it is not necessary even in relation to the results of the dual problem, in the sense that it necessarily holds every time condition (6) holds.

This can probably be clarified in several ways. Substantially, the question is to show that not only do the single values γ_i depend on the choice made regarding the α_i (in (2)), as is intuitive, but that the relationship existing between α_i and γ_i is such that if (6) is valid, and if the process of aggregation (2) is followed, (7) necessarily holds.

In fact, if (2) and (6) are both valid, we can write

$$\frac{1}{\gamma_i} z_i = \sum_i \alpha_i z_i \qquad (8)$$

Since the z_i represent vectors and γ_i and α_i are scalars, (8) is an equality between vectors. Taking the k-th elements in each of these vectors, we can therefore write

$$\frac{1}{\gamma_i} z_{ik} = \sum_i \alpha_i z_{ik} \qquad (8a)$$

from which comes

$$\gamma_i = \frac{z_{ik}}{\sum_i \alpha_i z_{ik}} \qquad (9)$$

which is the relationship that links the values of γ_i and α_i. It is clear that since the equality (8a) holds for all the corresponding elements of the vectors that appear in (8), the value of γ_i that can be obtained from (9) remains constant with the variation of the index k and depends only on the index i, which characterizes the element that represents the numerator of the fraction. It thus appears evident that once the value of the α_i is established, the value of the coefficient γ_i relative to each of the vectors z_i is unequivocally determined. Using (9) to calculate the value $\sum_i \alpha_i \gamma_i$, we obtain

$$\sum_i \alpha_i\gamma_i = \sum_i \alpha_i \frac{z_{ik}}{\sum_i \alpha_i z_{ik}}$$
$$= \frac{\sum_i \alpha_i z_{ik}}{\sum_i \alpha_i z_{ik}} \equiv 1$$

With this it is clear that the observations of Day [1, p. 803] concerning the possibility and the method of choosing suitably the α_i are meaningless. In these observations he seems to think that once the α_i are chosen, it should still be possible to choose between different values of γ_i without taking into account that the first choice implies also an unequivocal determination of the coefficients of proportionality.

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[1] DAY, RICHARD, "On Aggregating Linear Programming Models of Production," *J. Farm Econ.* 45:797–813, Nov. 1963.

[2] MILLER, THOMAS A., "Sufficient Conditions for Exact Aggregation in Linear Programming Models," *Agr. Econ. Res.* 38:52–57, April 1966.

EXACT AGGREGATION WITH LINEAR PROGRAMMING MODELS— A NOTE ON THE SUFFICIENT CONDITIONS PROPOSED BY R. H. DAY: REPLY

The redundancy in my aggregation theorem is clearly exposed by Marenco, and we can conclude that a proportionally heterogeneous aggregate can be represented by a single linear programming problem based on aggregate resources, as the aggregation theorem states, but with no further conditions. However, my statement about the choice of the aggregation weights (the α's) [1, p. 803] is not entirely meaningless, as Marenco asserts. We should merely make it stronger. For a pecuniously proportional aggregate, *any* weighted average of objective functions will do. Since the objective functions are proportional to each other, they are proportional to their average and the γ_i's needed for the theorem always exist.

This does *not* mean that any conditions of the theorem have been relaxed, only that one condition is implied by the others. Marenco is clear on this point· But a desire to obtain less restrictive hypotheses that would justify larger aggregates is a kind of theoretical snipe, which in between times has led some investigators off on what seems to me to be a pointless hunt.

Miller [6, p. 54], for example, hopes to get around the straight-jacket of proportionality by defining exact aggregation in terms of "qualitatively homogeneous output vectors," vectors whose optimal bases (including slacks) are the same for each firm. Unfortunately, his "theorem" leads to the following procedure: (1) Estimate the z_i, E_i, and c_i matrices for each farm $i=1, \cdots, n$. (2) Formulate and solve each l.p. problem; observe for each problem the optimal basis. (3) Group those farms together that have common optimal bases. (4) Aggregate the resources for these farms and solve the aggregate l.p. problem. In short, to obtain the aggregation solution we must obtain the individual solutions, *precisely the thing we were trying to avoid in the first place.*[1] Besides, the optimal basis depends on both z_i's and the c_i's, so that the groupings are not in general invariant to price mapping. We need the latter computation to get short-run output supply functions and input demand functions, which of course is one of the major applications of aggregate models. Instead of being "less than ideal" [6, p. 56], Miller's result is not an aggregation therem at all. It is merely a property possessed by the solutions of n individual l.p. problems with the same dimensions.

In an effort to overcome the shortcoming in Miller's approach, Lee [4] proposed to aggregate farms with identical dual solution vectors.[2] He thought this pointed the way to a true aggregation interpretation. Unfortunately, what is true of primal solutions is true of the dual solutions: they depend—both the levels and the bases—on *all the coefficients* of the matrices z_i, B_i, and c_i. To find the range of resource ratios over which the dual solution is constant would require parameterizing the l.p. problem for one firm for all possible variations in those ratios. Moreover, if we allow for variations in profit expectations, we must also parameterize the l.p. problem for all possible variation in the profit coefficient ratios. This leads to an inordinate number of computations, perhaps even more than required by directly computing the n individual l.p. solutions and adding them up.

The latter possibility is clarified by reasoning as follows: Let each member of a group of n firms be represented by an l.p. problem of the same dimension (m activities and k rows) with technological homogeneity ($B_i = B_j$, $i, j = 1, \cdots, n$). Let $\alpha = \max\{k,m\}$ and $\beta = \min\{k,m\}$. Then the number of groups into which the firms must be divided for exact aggregation within groups is bounded above by the number

$$(1)\quad \nu = \sum_{i=0}^{\beta} C(\alpha, i)C(\beta, i) = C(k+m, k)$$

where $C(p, q)$ is the number of combinations of p things taken q at a time. This number is equal to the maximum number of square matrices that can be formed from a B_i matrix or, as indicated by the last expression on the right, it is equal to the number of k dimensional square matrices that can be formed from a $k \times (m+k)$ matrix (B_i, I), where I is a $k \times k$ identity matrix representing "slacks" [2, p. 47].[3]

To illustrate: Suppose $m = 20$ and $k = 20$, a relatively small size for representing farm decisions by modern standards. The first term in the expansion (1) is 400 and the second is 36,100. The ninth term is the *square* of 184,756. The minimum number of subaggregates is thus in the hundreds of millions, many more than there are farms in the United States, which now number about 4,000,000.[4]

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[1] On this point see also [7].

[2] Incidentally, Lee is wrong in thinking, as he asserts on p. 59, that the individual firm dual variables in a proportionately heterogeneous aggregate are weighted by the relative share of the ith firm of the industry's aggregate resources. The weights are arbitrary, as re-emphasized above.

[3] The reason ν gives an upper bound and not the exact number of subaggregates required is because some (usually many) of the square matrices formed will be singular and not eligible as optimal bases. Only for models with special restrictions on the contents of the B_i matrices can an exact number be computed. An example is given below for the "Henderson Model."

[4] In Lee's graphical analysis $m = 3$, $k = 2$, so that $\nu = 10$ subaggregates (at most) required for exact aggregation. Lee, on the basis of graphical reasoning, obtained four

The *least* upper bound on the number of farms depends on the exact structure of the B matrix and may be much lower than given by formula (1). For example, if we assume a pure Henderson model [3; 2, Ch. II] with m crops so that $k = 2m+1$, we find that the exact number of nonsingular square matrices (bases) is

$$\nu' = \sum_{i=0}^{m} C(m, i) + m \sum_{i=0}^{m-1} C(m-1, i) = (m+2)2^{m-1}. \tag{2}$$

This is a much smaller number than the ν of equation (1). Suppose now that we consider an industry, each firm of which produces the same 20 commodities and determines production according to a pure Henderson model. Then $\nu' = 22(2^{21}) = 1{,}048{,}576$—more than 25% of the farms in the U.S.—and this is an oversimplified model indeed! Mighell and Black [5] indicated a sampling rate of 12 to 25 percent in order to obtain a good approximation to exact aggregation. Lee's procedure—even for a highly oversimplified model that gives the most favorable conditions—indicates a number of subaggregates at the upper limit of this amount.

We must, I think, reluctantly conclude that (1) it is likely that the maximum number of aggregates that could be identified by a sufficient amount of parametric programming would exceed the number of farms we have to aggregate in the first place; and (2) even if it does not, it will probably exceed the number (by several orders of magnitude) that we can afford to estimate and compute. While Lee was correct in guessing at a finite bound, he apparently overlooked the combinatorial properties of optimal bases in $m+k$ dimensions. I believe none would argue that the development of a million micromodels is economical, let alone feasible. Indeed, it seems we must look to other means of justifying the representative firm, microeconomic approach for estimating aggregate relationships—if we are to justify it at all.

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required subaggregates, but that result is based on the assumption that all producers have identical costs and returns expectations. The number derived here includes the possibility that within each resource grouping firms can have different profit expectations and must likewise be grouped according to profit ratio variations within which the optimal bases will not change.

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MYSTERIOUS MULTIPLIERS: COMMENT

In their recent article, Mirakhor and Orazem reach an interesting conclusion, namely, that in Kansas "a dollar of farm income generates more than twice as much total income as a dollar of nonfarm income" [1, p. 920]. They arrive at this conclusion first by developing farm and nonfarm income "multipliers" and then by comparing them. While their results are tantalizing, their "multipliers" are mystifying.

Mirakhor and Orazem define α_t to be the proportion of total income coming from the farm sector and β_t to be the proportion of total income from the nonfarm sector. Expressed in equation form [1, p. 915, equations (2) and (3)]:

$$\alpha_t = \frac{YF_t}{Y_t} = \frac{\text{Farm income in period } t}{\text{Total income in period } t}$$

$$\beta_t = \frac{YNF_t}{Y_t} = \frac{\text{Nonfarm income in period } t}{\text{Total income in period } t}$$

The authors then deduce the farm income "multiplier" to be $1/(1-\beta_t)$ and the nonfarm income "multiplier" to be $1/(1-\alpha_t)$ [1, p. 916].

Since total income is the sum of farm and nonfarm income [1, p. 915, equation (1)], substitution for alpha and beta will give:

$$\frac{1}{1-\beta_t} = \frac{Y_t}{YF_t}$$

$$\frac{1}{1-\alpha_t} = \frac{Y_t}{YNF_t}$$

What disturbs us most about the analysis is why anyone would think that total income divided by farm income or total income divided by nonfarm income in any way reflects income-generating effects. On the basis of this type of reasoning, the "multiplier" for the buggy-whip industry would be astronomical!

Perhaps there is a lesson to be learned here about deriving multipliers. When Lord Keynes derived his famous investment multiplier, he used a behavioral equation (the consumption function) and the accounting identity that total income equals consumption plus investment. Apparently Lord Keynes was not a clever enough mathematician to derive his multiplier only from the accounting identity.

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[1] MIRAKHOR, ABBAS, AND FRANK ORAZEM, "Importance of the Farm Sector to the Economy: A Multiplier Approach," *Am. J. Agr. Econ.* 50:913–920, Nov. 1968.

MYSTERIOUS MULTIPLIERS: REPLY

Farrish and Hardie seem to be suffering from "tunnel-vision syndrome." Their entire objection to our article can be summarized: "It can't be done this way; otherwise, Lord Keynes would have done it." Their objection is based on this weak form of "appeal-to-authority" line of logic. Overwhelmed by their enthusiastic skepticism, they have missed an essential aspect of the analysis.

Let us develop an argument similar to that of Farrish and Hardie. We start with an accounting identity [1, p. 115]:

$$Y = C + I \tag{1}$$

where Y is income; C, consumption; and I, investment. Now let (1) change by Δ to give us

$$\Delta Y = \Delta C + \Delta I \tag{2}$$

divide (2) by ΔY

$$1 = \frac{\Delta C}{\Delta Y} + \frac{\Delta I}{\Delta Y} \tag{3}$$

Let us designate $\Delta C/\Delta Y = \alpha$; (3) now becomes

$$1 - \alpha = \frac{\Delta I}{\Delta Y} \tag{4}$$

or

$$\Delta Y = \frac{1}{(1-\alpha)} \Delta I$$

or

$$\frac{1}{1-\alpha} = \frac{\Delta Y}{\Delta I}$$

where $1/1-\alpha$ is the Keynesian multiplier derived from the accounting identity.

We can now ask the following question: Why should anyone think that a change in income divided by a change in investment in any way reflects income-generating effect. Obviously, there is more to the analysis than the simple mathematical derivation. Confronted with such a question, which may have well been asked in an introductory economics course, one would have to explain the importance of the exogenous determination of investment and the linkage process existing between investment and income.

That is precisely what we tried to do in the early stage of the analysis and summarized the argument in Figure 1 of the article [2, pp. 913–914]. We set up a linkage process that relies on the "export-base" theory of the regional economists. To restate our case, we are talking about an agriculturally oriented economy with these characteristics: (1) farm income is a substantial portion of the total income in the economy; (2) there are major industries in the economy that have either forward or backward linkages with the farm sector; (3) a major portion of the demand for the output of the farm sector is exogenously determined; and (4) the farm sector contributes a major portion of its income to the nonfarm sector via (a) farm production expense and (b) farm sector's direct consumption of nonfarm sectors' output.

The "buggy-whip" industry of Farrish and Hardie, having none of those characteristics, is totally irrelevant in the linkage process, which Farrish and Hardie apparently missed.

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[2] MIRAKHOR, ABBAS, AND FRANK ORAZEM, "Importance of the Farm Sector to the Economy: A Multiplier Approach" *Am. J. Agr. Econ.* 50:913–920, Nov. 1969.

A NOTE ON THE MEASUREMENT OF PRICE ELASTICITY OF DEMAND

The November 1968 article by Lyon and Simon [1] presents an interesting and useful measure of price elasticity of cigarettes. I would not hesitate to use their approach given similar circumstances—at least as a check on other methods, and possibly as the preferable method.

However, the approach has a few problems of its own, so that the case for selecting it over other methods is somewhat overstated in the November article. Some of these problems are correctable—at least approximately—so it may be useful to discuss them. In some special cases no corrections will be needed, but it is advisable to try to determine such cases through analysis, rather than assume it at the outset.

The most obvious and important problem is that the approach recommended skirts the issue of the demand function underlying the elasticity estimate. Subtracting $(Q_3-Q_4)/Q_4$ in the "control" cities implies the authors had in mind an additive model, but nowhere do they indicate they have considered this question. A model linear in logs might seem more reasonable for cigarette demand; if so, this would suggest dividing by $(Q_4-Q_3)/Q_3$—not subtracting. The latter could produce significantly biased estimates of elasticity. In any case, it is clear that the adjustment represented by $\Delta q/q$ is best derived from a consciously chosen model and is *not* the same for all models.

A second problem, related to the first, is the assumption (again not explicitly stated) that the factors implicitly represented by $(Q_4-Q_3)/Q_3$—i.e. all non-price factors, such as economic or population growth—remain the same in the "test" city as in the average of the "control" cities, over the time period used. This is not only highly questionable, but is very unlikely to be the best (or even a very good) way of adjusting for such non-price variables. Cigarette demand is very likely to be dependent on population and economic growth, for example. Such growth is measurable and different among states. Even a rough recognition of this in the method—surely possible—would be better than assuming that no differences existed.

A simplified example might help illustrate the above points: Suppose demand for cigarettes were a function, linear in the logs, of price and disposable personal income:

$$q = a_0 P^{a_1} E^{a_2}$$

with values

$$a_0 = a_2 = 1$$

and

$$a_1 = -1$$

or

$$q = P^{-1}E$$

Then, by definition, $\epsilon = (dq/q)/(dp/p)$; or $\epsilon = -1$.

And suppose values of the variables (measured relative to quantities at Time 1) are:

Time	"Test" city			"Control" cities (average)		
	q	p	E	q	P	E
1	1	1	1	1	1	1
2	1.32	.833	1.10	1.10	1	1.10

Then arc elasticity, as measured by the authors, is:

$$\epsilon_{\text{arc}} = \frac{(\Delta q/q)_T - (\Delta q/q)_c}{(\Delta P/P)_T}$$

$$= \frac{.32 - .10}{-.167} = -1.32$$

Thus, when this model applies, which is not unreasonable for cigarette demand (except that more variables might be needed), the proposed method results in a 32 percent bias. The bias would be reduced to 20 percent if we *divide* $(\Delta q/q)_T$ by $(\Delta q/q)_c$. In this example, the remaining bias is due to using $\Delta q/q$ for dq/q for moderately large price changes. This error is not incurred when elasticity is derived directly from the model.

If, as implied by the method, a linear model is adequate for explaining cigarette demand, then it is even more important to explicitly recognize the assumed model, since price elasticity will not be constant for different levels of price and quantity.

An additional bias would have occurred had we not assumed equal change of +10 percent in the economic variable.

The above discussion is not intended to discredit the authors' approach. I consider it very helpful in many circumstances and have frequently used it. Rather, I am suggesting that the approach would benefit from a more careful and explicit consideration of the underlying demand model, and from a more careful and explicit consideration of the non-price variables involved. There are several ways this could be done, including combining time series analysis with the authors' approach in a multi-stage procedure. The results would be both theoretically and practically more satisfying and convincing than those presented in the November article.

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[1] LYON, HERBERT L., AND JULIAN L. SIMON, "Price Elasticity of the Demand for Cigarettes in the United States," *Am. J. Agr. Econ.* 50:888–895, Nov. 1968.

ECONOMICS OF COST-SHARE LEASES: COMMENT

In an article entitled "Economics of Cost-Share Leases in Less-Developed Countries," Adams and Rask [1] offered a cumbersome geometrical analysis, which led them to show the following:

(a) A *traditional lease* leads to a use of variable factors of production that is short of the use under the assumption of perfect competition and no lease.

(b) An *ideal lease* leads to a normal use of variable factors of production. That is, an ideal lease leads to profit maximization identical with what would have been under perfect competition and no lease.

(c) Replacing the *traditional lease* by an *ideal lease* leads to a *cost-sharing puzzle*: The tenant would definitely benefit from adopting the *ideal lease* instead of the *traditional lease*; the landowner may or may not.

(d) *Traditional leasing* arrangements are exploitative: The tenant receives a smaller net return under *traditional leasing* arrangements than he could have received under an *ideal leasing* arrangement.

Since traditional leasing arrangements are exploitative, Adams and Rask conclude erroneously that some type of societal pressure should be applied in order to force landowners to participate in paying variable costs.

For the benefit of the reader, it is recalled that the *traditional lease* is an arrangement in which the landowner does not participate in paying variable costs. In return for using the land, the tenant pays the landowner a certain proportion of the crops. The *ideal lease* is an arrangement in which the landowner participates in paying variable costs in the same proportion as he shares crops.

The Correct Analysis

Let us start the analysis by focusing on an individual farm that utilizes three factors of production, A_1, A_2, and A_3. A_1 and A_2 are variable factors; A_3 is fixed. The farm sells its output at a price of P, and pays prices P_1 and P_2 for the variable factors. Let the production function be

$$Q = f(A_1, A_2, A_3) \tag{1}$$

Then under the traditional leasing arrangement where the landowner shares half of the crops, the tenant would attempt to maximize the following profit function

$$\pi = 1/2PQ - P_1A_1 - P_2A_2 - P_3A_3 \tag{2}$$

Differentiating (2) with respect to the variable factors of production and setting the derivatives equal to zero gives

$$\begin{aligned} \frac{\partial \pi}{\partial A_1} &= 1/2p \cdot f_1 - p_1 = 0 \\ \frac{\partial \pi}{\partial A_2} &= 1/2p \cdot f_2 - p_2 = 0 \end{aligned} \tag{3}$$

where

$$f_1 = \frac{\partial Q}{\partial A_1} \quad \text{and} \quad f_2 = \frac{\partial Q}{\partial A_2}$$

$P \cdot f_1$ is the marginal value product (MVP) of A_1 and $P \cdot f_2$ is the marginal value product of A_2. Accordingly, (3) can be written as

$$\begin{aligned} 1/2(MVP)_1 &= p_1 \\ 1/2(MVP)_2 &= p_2 \end{aligned} \tag{4}$$

Relations (4) prove proposition (a), namely, that a traditional lease would lead to under-utilization of variable inputs. Instead of seeking a level of output at which the prices of the inputs are equated with their respective marginal value products, the tenant would seek a lower level of output at which the prices of the variable inputs are equated with half of the respective marginal value products.

Suppose the traditional lease is replaced by an ideal lease. The landowner participates in paying half the total variable cost. The profit function considered by the tenant is

$$\begin{aligned} \pi^* = 1/2PQ - 1/2(P_1A_1 + P_2A_2) \\ - P_3A_3 \end{aligned} \tag{5}$$

Differentiating (5) with respect to the variable factors of production A_1 and A_2, and setting the derivatives equal to zero gives

$$\begin{aligned} \frac{\partial \pi^*}{\partial A_1} &= 1/2p \cdot f_1 - 1/2p_1 = 0 \\ \frac{\partial \pi^*}{\partial A_2} &= 1/2p \cdot f_2 - 1/2p_2 = 0 \end{aligned} \tag{6}$$

This proves proposition (b), namely, an ideal lease leads to a normal use of variable factors as follows:

$$\begin{aligned} (MVP)_1 &= P_1 \\ (MVP)_2 &= P_2 \end{aligned} \tag{7}$$

One does not need to "toy" with much geometry to prove proposition (c). Under both arrangements we can look upon the tenant as a producer who, out of each additional pair of units of output, retains one unit for himself and gives one to the landowner. This means that for the tenant, the extra cost of producing one additional *retained* unit under a traditional leasing arrangement is twice the extra cost under the ideal leasing arrangement. Thus, if the price of output does not change, the tenant would always benefit from switching to the ideal leasing arrangement. To show that the landowner may or may not benefit from the switch, consider the following Cobb-Douglas production function:

$$Q = KA_1^{\alpha}\cdot A_2^{\beta}\cdot A_3^{\gamma},\quad \alpha+\beta+\gamma = 1 \tag{8}$$

Let A_1 and A_2 be the variable inputs and let A_3 be land. Let Q_0 be output under traditional leasing arrangements and Q_1 output under an ideal leasing arrangement. Then, under the traditional lease the rent of the landowner is $1/2Q_0P$, and under an ideal lease his rent amounts to $1/2Q_1P-1/2(\alpha+\beta)Q_1P$ which is equal to $1/2\gamma Q_1P$. The expression $1/2\gamma Q_1P$ may be either lower or higher than the expression $1/2Q_0P$. This is true because $Q_1>Q_0$ and $0<\gamma<1$.

Who Exploits Whom?

Dale and Rask imply that the tenant is exploited under the traditional leasing arrangement. They prove it by resorting to geometrical analysis to show that an ideal lease would yield a higher income for the tenant than the traditional lease.

But suppose for the sake of argument that one wants to adopt the criterion of paying resources according to their value of marginal physical product. Then clearly the one who is being exploited under the ideal lease is the landowner who receives only half of the VMP of land which, under the assumption of a Cobb-Douglas production function, is γQ_1P. If in our example the tenant provides input A_1, then under the ideal lease the tenant exploits the landowner: In addition to αQ_1P which is his VMP, he is paid $1/2\gamma Q_1P$, which is a half of the VMP of land. This leaves the landowner with only a half of what he "deserves."

A Fallacy of Composition

Suppose, again for the sake of argument, that tenants are exploited. Would some type of societal pressure on landowners to accept ideal leasing arrangements be beneficial to tenants? The answer to this question is not necessarily positive. It can be shown that, given a certain aggregate production function and some realistic assumptions concerning price elasticity of the demand function for farm output, tenants might lose from switching to the ideal lease. To illustrate such a possibility, consider a farm sector whose production process can be approximated by some Cobb-Douglas function. Assume further that farmers as a whole are confronted with an aggregate demand function for output with price elasticity of $-1/2$.

Suppose that, under the traditional lease, the system can be described as follows:

(9)

Demand:

$$Q = 20P^{-1/2}$$

Production Function:

$$Q = A_1^{1/4}A_2^{1/4}10^{1/2}$$

Factor A_1:

$$1/2\left(1/4\frac{Q}{A_1}\right)P = 1/2,\quad P_1 = \$1/2$$

Factor A_2:

$$1/2\left(1/4\frac{Q}{A_2}\right)P = 1/2,\quad P_2 = \$1/2$$

System (9) is in equilibrium when $A_1=A_2=10$, $P=\$4$ and $Q=10$. The net profit of tenants is calculated as follows:

$$\begin{aligned}\text{Net profit} &= 1/2Q_0\cdot P_0 - A_1^0P_1 - A_2^0P_2\\ &= 1/2\ 10\cdot 4 - 10\cdot 0.5 - 10\cdot 0.5\\ &= \$10\end{aligned}$$

where A_1^0 and A_2^0 denote A_1 and A_2 under the traditional lease.

Switching from the traditional lease to the ideal lease, the system becomes

Demand:

$$Q = 20P^{-1/2}$$

$$
\text{(10)}\quad
\begin{aligned}
&\text{Production Function:}\\
&\qquad Q = A_1^{1/4}A_2^{1/4}10^{1/2}\\
&\text{Factor } A_1:\\
&\left(1/4\frac{Q}{A_1}\right)P = 1/2, \qquad P_1 = \$1/2\\
&\text{Factor } A_2:\\
&\left(1/4\frac{Q}{A_2}\right)P = 1/2, \qquad P_2 = \$1/2
\end{aligned}
$$

System (10) is in equilibrium when $A_1 = A_2 = 15.87$, $p = \$2.52$ and $Q = 12.6$. The net profit of tenants is calculated as follows:

$$
\begin{aligned}
\text{Net profit} &= 1/2Q_1P_1 - \tfrac{1}{2}[A_1{}^1P_1 + A_2{}^1P_2]\\
&= \tfrac{1}{2}\,12.6 \times 2.52\\
&\quad - 1/2[15.87\cdot 0.5 + 15.87\cdot 0.5]\\
&= \$7.95
\end{aligned}
$$

where $A_1{}^1$ and $A_2{}^1$ denote A_1 and A_2 under the ideal lease.

That is, if one is careful to avoid falling into the trap of the *fallacy of composition*, or, if one does not forget that when national policies are involved prices of outputs can no longer be assumed constant, then one can show that tenants will not necessarily benefit from switching to the ideal lease. I don't believe that Adams and Rask could claim that my assumptions, as presented in equations (9) and (10), are unrealistic. There probably are underdeveloped countries in which the price elasticity of demand for output is higher than the absolute value of $-1/2$, as well as countries in which it is lower than the absolute value of $-1/2$. But, on the whole, once the demand curve for farm output becomes inelastic, one cannot unambiguously claim that the traditional lease is exploitative. As shown in our model, under the traditional leasing arrangement tenants received \$10, while under the ideal lease their net gain was reduced to \$7.95.

It is impossible to determine unambiguously who exploits whom. Even if we consider a single farm for whom the price of output is constant, it is possible to show that landowners are exploited under the ideal lease, provided that our welfare guiding rule is paying inputs their value marginal products.

A national policy aimed at switching from a traditional leasing to ideal leasing arrangement might impoverish tenants. This is in particular likely if the aggregate demand for farm output is inelastic with respect to price.

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Reference

[1] ADAMS, DALE W, AND NORMAN RASK, "Economics of Cost-Share Leases in Less-Developed Countries," *Am. J. Agr. Econ.* 50:935–942, Nov. 1968.

ECONOMICS OF COST-SHARE LEASES: A REPLY

We are pleased that Professor Gisser was sufficiently interested in our article, and particularly in one of the footnotes, to work up an alternative presentation of our argument. This he does in the first part of his comment. He is apparently disturbed by the geometry rather than by our conclusions, since he agrees that tenants will always benefit by adopting a cost-share lease and that landowners may not. He is thus in full accord with our main point that market forces in LDC's will probably not be sufficient to resolve, through cost-sharing, the resource inefficiencies involved in share-rental arrangements. Aside from the capacity to generalize for more than one variable input, his analysis is identical with our own.

Gisser goes on to question our normative definition of exploitation: A tenant is exploited to the extent he realizes less under a non-cost-share lease than under cost sharing. As an alternative, he suggests that exploitation be defined on the basis that an owner of a resource *ought* to be paid the value of its marginal product. Although sanctified by economic usage, his definition is also normative. This is not surprising since exploitation is an emotive, value-laden term which cannot be defined objectively.

Although we are not married to our particular definition of exploitation, we do feel that it is operational and can be useful in addressing major policy issues. For example, from a social viewpoint important inefficiencies in resource utilization result from share leases in LDC's. Commonly, widespread poverty also exists among tenants, and short falls occur in agricultural output. All three of these problems can be at least partially alleviated by eliminating exploitation as we define it. As we suggest in our paper, cost-share leases are only one of the tools that might be used. A strong argument for land reform could also be made.

Somewhat different policy conclusions might be drawn from Gisser's definition: (1) Landlords are likely to be "exploited" through adoption of cost-share leases. Policy conclusion: traditional leases are more desirable. (2) It is very likely that many landlords are also being "exploited" under traditional leases. Following Gisser's formulation, and assuming a traditional lease, it is very possible that the payment made to tenant's labor, if based on its VMP, would be less than his share of total output. Policy conclusion: remove the tenant from the land or lower the share of output that he receives. (3) If a tenant's VMP for his labor is low, it implies that he is providing a poor quality input and should be rewarded on that basis. Policy conclusion: most of the income stream should go to the landowner; land has no particular social function and Ricardian rent does not exist; Malthus should reign; the distribution of landownership is inviolable; tenants should be denied access to activities that are almost synonymous with control of land, such as education, political power, and health services; tenants in countries like Bolivia were not justified in forcing land reform since they may have already been taking advantage of landowners under their traditional leases.

In the last part of his comment, Gisser is of course correct in stating that increased output resulting from resolution of resource inefficiencies inherent in share leases could have an adverse price-income impact on tenants. His assumptions, however, are rather restrictive. We readily grant that farmers in LDC's face a domestic aggregate demand schedule that is inelastic. The following qualifications, nevertheless, might alter his conclusions: (1) share tenants may only produce and market a small part of total output; (2) tenants may be producing commodities that have relatively high price elasticities; (3) increased output may substitute for imports and have little or no impact on domestic prices; (4) technological innovations may substantially reduce production costs so that tenants realize more net income in spite of lower product prices; (5) substantial amounts of increased production might be consumed on-farm and have little-or-no effect on product prices; and (6) major increases in agricultural output may be absorbed by demand schedule shifts which result in little price change. This will likely occur because of the rapid growth in population, expanding incomes coupled to high average and marginal income elasticities of demand for agricultural commodities, and rapid growth in demand for agricultural raw materials to fill industrial needs.

Professor Gisser's quest for the black-hat-wearer in the tenant-landowner relationship will not be very useful to the social minded, equity oriented policy maker, but should warm the cockles of landlord's hearts.

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TRAINING FOREIGN GRADUATE STUDENTS IN AGRICULTURAL ECONOMICS: FURTHER COMMENT

This is a rejoinder to the thoughtful and constructive comment of Professor Heraclio Lombardo [1] on my article on the training of foreign graduate students [2]. I wish to endorse or supplement some of his suggestions and observations and to carry further certain statements that I made in the article.

Professor Lombardo notes that Latin America is part of the Western World and is therefore, presumably, heir to the "Greek" system of thinking; yet, many Latin American students suffer disabilities such as he has noted in their efforts to develop scientific procedure in working on agricultural problems and policies, just as if they did not have a "Greek mind."

The practical problem certainly is as Professor Lombardo has described it and, in my observation, the basic reason is that yes, indeed, the typical Latin American scholar does not have a Greek mind, even though his ancestors once did. The accomplishments and attitudes of the Greek mind, which forever sought for the causes of all things observed by the senses, were passed on to the Western World, including Italy and Spain, in the Renaissance. As far as science was concerned, the important thing that was reborn was the *search* for an improved understanding of this world's phenomena, for which freedom of thought and expression was essential. In those parts of Europe where the Protestant Reformation of the 16th Century was successful enough to break the governance of the Church over the procedures and conclusions of inquiries into the natural order, the scientific Renaissance survived and continues down to our own day; but in such countries as Spain and Italy, inquiry was stifled through an authoritarian control of thought as soon as the Church discovered that the results were not in accord with received doctrine, and the newly reforged connection with the Ancients was thus again broken.

Another very important difference which arose was that in countries where Protestantism could not be suppressed, and religion for a majority or a substantial minority came to rest on the individual's interpretation of the written Word, more than on the dictates of Church authority, a zeal for promoting literacy among the general, humble populace was suddenly born; but no such zeal, except perhaps in some cases in recent years, was ever felt in countries where the Reformation utterly failed or did not occur, or in the former colonies of such countries.

The world over, the nature and quality of thought on religion and on other most basic philosophical matters sets the tone of *all* thought. It also conditions the purpose, and therefore the method, of education. Science can hardly be really indigenous where freedom of inquiry and expression in these more fundamental fields does not also fully prevail.

A practical illustration of how the tradition of authoritarianism in thought affects the progress of science may be useful. In visiting a remote branch experiment station in one of several Latin American countries where I have worked, I observed that the young scientists there, of whom some had been trained in the U.S.A., had been supplied with U.S. autoclaves and other expensive research machinery of recent design but lacked the electric power and hot water connections that were necessary in order to operate these machines. They also had no scientific library. To my suggestion that they write to their superiors in the capital city and explain their situation and how little it would cost to correct it, they replied, "You don't understand. In this country we are organized on the basis of the *principle of authority.* All suggestions must therefore come from the top down, and if we wrote such a letter as you suggest we should probably lose our jobs."

Other illustrations could be given. I would not wish to leave the subject without saying, however, that there are signs of lessened authoritarianism and a growth of freedom of thought within the Church in Latin America, and that these may be among the most hopeful signs now visible that science and its benefits may eventually become truly indigenous there.

Passing on to other points made by Professor Lombardo, I agree that the training of foreign students should certainly include the "theoretical, philosophical and empirical conception and application" of research. In discussing the principal subjects that I thought they should study, I had in mind, without saying so clearly enough, that research methods, research results, and the use of research results should be taught as an integral part of each subject mentioned. I believe that instruction on research has to be made very specific and must include actual research itself, if it is to be truly effective, and so am inclined to favor a succession of research experiences and a succession of illustrations of how the results of research have influenced the formation of principles, in the teaching of each subject. I think that this would weave the necessary connection of principle to reality that is lacking in the non-Greek mind, as well as supply the needed tools of inquiry. If a *generalized* course in research methods were given, I would suggest that this be done after students had become thoroughly familiar with the aspects of research that Professor Lombardo has so well stated, but through observation, instruction, and experience of research on very concrete matters. A general course might then serve to consolidate and systematize the student's previous learning in this field.

My feeling about a course in logic is somewhat similar. If it were given early and as a hoped-for means of promoting logical thought on concrete subjects to be studied later, I anticipate it would merely be memorized, just as mathematics generally now is, as an easy course in which to make a good grade, and that it probably would not affect the quality of subsequent thinking on any aspect of reality. At the very end of training, however, after the student had learned to think logically on concrete propositions by being assisted to do so, in case after case, then I think perhaps a course in logic would be useful in codifying and systematizing a way of thinking in which the student had already become proficient in a practical way. Thus, in respect to courses in *general* research method and logic, I feel that the psychologically efficient order of procedure is probably not what might seem logical at first.

A good course in agricultural policy, I agree, would offer an excellent chance for the student to bring to bear on large questions currently being debated in his country and in our own the information and the scientific system of thought which he would have acquired in wrestling with the more basic subjects such as farm management, marketing, prices, and the like.

As to prices, in these days when—I believe because of national and international monetary policies—the international terms of trade of nations selling mostly farm products and other basic goods have become so unfavorable, it seems to me that instruction in price-making factors and how they actually operate would be one of the foundations for a full discussion of national agricultural policy. On the difficulties of providing this instruction or of putting it into practice in many of the countries whose students need it, I fully agree with Professor Lombardo, but think that the game will be well worth the candle wherever we can at all manage to play it.

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SOME RESPONSES OF RICE FARMERS TO THE PACKAGE PROGRAM IN TANJORE DISTRICT, INDIA: COMMENT

In a recent Ford Foundation study [1] reporting on the responses of rice farmers to the Package Program in the Tanjore District of South India, Malone presented data that show a paradoxical situation—a situation in which hired labor is being used even when "surplus" family labor is available. "Very small" farms use about 24 percent of available family labor; "small" farms, about 22 percent; "medium" farms, 18 percent; and "large" farms, 40 percent. It will be instructive to note that family labor accounts for about 60 percent of all labor used on very small farms; 35 percent on small; 25 percent on medium; and 18 percent on large farms. The rest is hired labor. The question naturally arises: why do Tanjore farmers use hired labor when family labor is available? Malone explains [1, p. 260]:

> . . . Usually less than half of the family's available time was productively employed even on very small farms. Rice growing is messy work under irrigated conditions in India and the farmer excuses himself from working knee-deep in mud in the tropical heat. With wages at 30 to 60 cents per day for men and half that for women, hired labor seems a good alternative even on quite small farms.

Is this a rational economic explanation of the behavior of Tanjore farmers? From the economic standpoint, use of hired labor is inconsistent with a situation where "surplus" family labor is available, unless the farm family attaches a great value to leisure, greater than the wages, as Malone seems to imply. Let us examine the evidence to see whether these farmers are as economically irrational as Malone contends.

The very small farms, averaging 1.4 acres in size, would increase its net income from $115.40 to $146.60 if no hired labor was used. This is an increase of $31.20, by no means a small amount under Indian conditions. These figures apply to 1962–63, when this study was made and when per capita income was about $71. In the light of this information, it should be apparent that hired labor is not, after all, such a good alternative to farmers as Malone has argued. The increases in net farm income for the small, medium, and large farmers average $86.4, $168.7, and $525.2 respectively, if they did not use hired labor. In other words, very small farms would increase their net incomes by about 27 percent; small, medium, and large farms by 34 percent, 33 percent, and 42 percent, respectively, in case no hired labor was employed. Except in the case of large farms, this would seem possible because available family labor is much more than the total amount of labor used. Does not all this suggest that farmers in Tanjore would not employ hired labor if they could possibly avoid it? If that is so, what is the basis of Malone's contention that the rice farmers of Tanjore district prefer leisure to work at such "low" wages?

A closer look at Malone's data would show where he could possibly have made a mistake. According to him, "family labor available is the number of adult males multiplied by 12, plus months of field work actually done by women and children converted to man-months" [1, p. 259]. This is apparently a measure of the amount of labor available for the whole agricultural season. Such a calculation ignores the important fact that the unemployed labor of one period (slack season) cannot be transferred to another period (busy season). At the time of seasonal peak demands there is a shortage of labor, and that explains the use of hired labor.

In trying to measure the "progressiveness" of Tanjore farmers, one criterion Malone used was the rate of use of "package" inputs. He observes [1, p. 262]:

> A rather surprising result emerged. These heavier users of improved practices proved to be, without exception, small or very small farmers who concentrated on

one crop of long duration rice per year. They did get good yields, 3050 pounds per acre as a normal yield, which is about 30 percent above average. But with only one crop to harvest, their total yield per acre of farmland was very little different from that of the average small farmer who double cropped over one-fourth of his acres; however, they did save on hired labor.

The behavior of this group is not difficult to rationalize. Hired labor accounts for the largest single item of expenditure in all categories of farms in Tanjore. Therefore, saving on hired labor whenever possible is a rational economic proposition for the farmer. It would not have been so if it were true that "with wages at 30 to 60 cents per day for men and half that for women, hired labor seems a good alternative even on quite small farms."

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Reference

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OUR JOURNAL—A VIEWPOINT

The editor's note preceding the communications section of *AJAE* points out the appropriateness of suggestions for improving AAEA [1]. This would appear to qualify *AJAE* itself as a legitimate focus for comment.

Beginning with Volume 48, No. 1 (February 1966), the *JFE*, now *AJAE*, became a more frustrating journal because of the adoption of the new reference procedure by which numbers in brackets were put in the text and the reference listing placed at the end of the article. That this procedure is generally in use now and that it simplifies the author's task a little is true. Yet, something is lost.

The purpose of a reference citation, and an extremely useful one, is to relate ideas to the literature from which they come. With the present format of *AJAE*, this is more difficult and ultimately less successful, even with the increased effort by the reader who constantly has to turn to the last page to decipher the bracketed number code. A return to our older form would make *AJAE* more useful to its readers. I share Professor Paarlberg's [4] footnote frustration. I keep wanting to see things at the bottom of the page.

While I am demonstrating what some will see (but I deny to be) as innate intransigence, I may as well mention a more recent change in *AJAE*.

When a man's association with an institution is more important than his name, then we really must be in an "associationistic age" [3]. The *News Notes* [2] feature institutions first and people second. It conserves space, but it makes the section more difficult to digest if the main interest is in friends and not institutions. Although such was certainly not intended, it strikes me as a bit dehumanizing in that it suggests where I work is more important than who I am. Sometimes change is not progress, and I think this is one of those times.

But for the fact that I hypothesize I am not alone in these feelings, this would have been a letter to the *AJAE* editor. Because the hypothesis seems worthy of test, the matter should be on the agenda of all our members; thus, this is not a letter but a communication.

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[3] BREIMYER, HAROLD F., "The AAEA and USDA in an Associationistic Age," *Am. J. of Agr. Econ.* 50:1101, Dec. 1968.

[4] PAARLBERG, DON, Review of Thomas' *The Politics of Food for Peace, Am. J. of Agr. Econ.* 50:172, Feb. 1968.

A FEW COMMENTS FROM THE EDITORS— IN RESPONSE AND OTHERWISE

In addition to matters raised by Robert Bevins, some related points needing explanation may justify our adding a fraction to AAEA's financial obligation for the Journal. We have not, however, earned ourselves much space from success in exhortation of authors toward brevity and economy.

Earl Swanson explains that the change in handling references was in part the result of a mutual understanding among editors of social science journals. A standard format was seen by the group of editors as having the advantage "that manuscripts rejected by one journal can be sent immediately to another journal without expensive retyping and increased chances for errors." Earl added: "We also wanted to have a uniform procedure within the Journal"; but he did not explain why our current procedure was the one selected for uniformity.

An earlier change also has been questioned: why did we take the beginning of the table of contents off the front cover? We asked Jim Nielson, in whose editorial regime that occurred. In reply, he first mentioned "esthetics—we could see no reason why a professional journal could not be made more interesting, on the outside at least." (With never-ending display of that exciting plow and eagle, Jim?) Then, after also mentioning orderliness, he got down to the compelling reason: "We discovered that a number of libraries and other institutions cut off and destroy the covers when they bind professional journals." *AER* nullifies this fiendishness by reprinting the beginning part of its table of contents on the first inside page. But that costs something—approximately the equivalent of one of our typical articles every three years—though a lot less than we are now saving on *News Notes, Personal.*

Which is the lead-in to Bevins' second point—that we put "institutions first and people second," in the *News Notes* of the February issue. In February we published 217 personal items (other than obituaries) on 7½ pages. The past system of individualized news notes has required a page for approximately 12½ items. Thus, by not reprinting institutions' names and obvious recurrent phrases, we saved 10 pages. (There are two 10-page articles in the February issue.) But no less important is our belief that readers are interested in the doings of institutions as well as friends. If we had alphabetized, would the personnel dynamics of ERS have been so readily apparent? Or the restaffing of economics at Colorado State?

Further, with respect to institutionalization (our choice over "associationism"), we see no good reason for not presenting the list of doctoral degrees awarded by conferring institutions; our Editorial Council, to the extent of its response to our inquiry, is favorable.

Beyond all other pros and cons, this way of handling news notes and doctoral degrees has the advantage for the editors of automatic revelation and self-chastisement of those failing to report on time (or at any time).

A third question has been raised—regarding the Journal's long-established review procedure. Would-be authors occasionally allege that bias, prejudice, caprice, stupidity, or what not obstructs publication and that reviewers can get away with this because they are anonymous. But reviewers are not anonymous to the editors, nor are their recommendations binding upon us. If we believe we have encountered malevolence (which is almost never) or ineptitude (once in a while) or carelessness (a little oftener but still not frequently), we try to employ an appropriate discount factor. We occasionally obtain reviews that are more deserving of publication than the manuscript reviewed. However, there are proposals (as well as practices in other journals) that the author be anonymous to reviewers. And we have a proposal that would invert our present procedure—author anonymous to reviewers, the latter identified to the author.

With this issue of the Journal, we initiate a *Research Notes* section, or, for older members, we revive the non-communication part of our erstwhile *Notes* section. *Communications* will remain, as of course will *Articles.* With three categories, we believe we will have the flexibility needed to better serve authors and readers.

We hope that those who have discovered new data or have tried or developed new techniques or have something to say on similar matters (including technical approaches used by industry and extension economists) will think of *Research Notes.*

It should not always be necessary to write fulsomely on theoretical background or report data in great detail. Authors occasionally tell us that when their studies have not yet produced enough to justify an article, senior colleagues have advised their sending in a *Communication.* But a *Communication* usually it is not; so please, senior colleagues, hereafter suggest the possibility of a *Research Note* (and be sure that you both look at the rules on the inside back cover).

Communications, minus those items that will be carried as *Research Notes,* will remain about as heretofore. The only reason for "about" is that we want to encourage a broad interpretation of the prefatory *Editor's Note.* Robert Bevins has correctly interpreted it to include *AJAE.* With little strain upon imagination, "topics of in-

Reviews are listed alphabetically by authors.

Reviews

Aranda, Sergio, *La Revolución Agraria en Cuba,* Mexico D. F., Siglo XXI, Editores, S.A., 1968, vii + 240 pp. (28 pesos mexicanos)

On January 1, 1959, the Cuban dictator Batista fled Cuba. Barely six months later the new government issued its first land reform law. Four years later this was followed by a second law which abolished all private farms in excess of 67 hectares.

Sergio Aranda does not answer all the questions that a student might ask about what has occurred in the 10 years during which the structure of the country's agriculture underwent a thorough change. Aranda worked eight years in Cuba and has, to all appearances, a detailed knowledge of the land reform, its problems and accomplishments. He is a great admirer of Cuba's achievements and tries to induce his readers to share his enthusiasm. At times, his passion seems to run away with him when he leaves some particularly important growth issues unexplained. His statistical material is thin and not always well presented, although it is not certain whether this is entirely his fault or that of the absence of official data. Nonetheless, Aranda's book is valuable: it is one of the best analyses of the most thorough land reform in Latin America.

There are certain aspects of Cuba's new agriculture that no real development economist can afford to ignore. As in Mexico 58 years ago, Cuba's farm land was controlled mostly by a few owners of large estates, of whom many were foreigners. Agricultural resources were pitifully unused and underutilized. The level of technology was low; rural unemployment high. Today the land is divided, as in some other socialist agricultures (e.g., Poland's or Yugoslavia's), in two large sectors: the state sector, which controls about 70 percent of the farm land; and the private sector, which controls the remainder. This contrasts with the industrial sector, which is almost entirely state owned. The private producers account for 80 percent of Cuba's coffee, 85 percent of its tobacco, and an important share of other products.

Perhaps the most remarkable fact: rural unemployment not only seems to have disappeared but actually has been replaced by an acute shortage of manpower. The cause of this development appears to be the ambitious production plans of the Cuban government and the massive movement of manpower to industries and public work programs. These have made it necessary to draw on volunteers from urban centers as well as on women workers. Here then is a Latin American agriculture where everybody finds a paying job! According to Aranda, the level of living of the rural labor force has been raised substantially although, in contrast with other countries, this seems to have been achieved until now at the expense of the welfare of the urban population. All in all, a sharp contrast with the remainder of the continent where the millions of unemployed and underemployed, whose numbers are rapidly growing, appear to present an almost insoluble problem. An interesting side-aspect of this transformation may be the change in mentality of the Cuban population towards farming and farm work, which in many underdeveloped countries is regarded at best as a fourth-rate occupation.

Another change has been the organization of the labor force. In most of Latin America, farm people are not encouraged to organize. According to the I.L.O., in 1964 about 1 percent of the rural population were members of cooperatives. In the rural communities dominated by the owners of large estates, cooperatives are regarded as subversive. In Cuba, according to Aranda, most of the private producers who are on units up to 67 hectares belong to one of three cooperatives. Obviously without organization, farm people cannot be expected to participate in the realization of the ambitious goals of increased production and diversification. But obviously the organization of farm people could be undertaken only after feudal paternalism had been abolished.

Finally of interest is the awesome infra-structural work in which an underdeveloped country has to engage, when starting from as low a level as Cuba, before it can compete with modern agricultural economies. Here Aranda makes a real contribution when he gives insights into the lack of research and research facilities, the need for raising technological levels and the education of farm people, and the efforts of the Cuban government to overcome them.

Notwithstanding its shortcomings, this booklet deserves to be translated into other languages.

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Behrman, Jere R., *Supply Response in Underdeveloped Agriculture. A Case Study of Four Major Annual Crops in Thailand, 1937-1963*, Amsterdam, North-Holland Publishing Company, 1968, xx + 466 pp. ($22.50)

Yotopoulos, Pan A., *Allocative Efficiency in Economic Development*, Athens, Center of Planning and Economic Research, Research Monograph Series 18, 1967, 313 pp. Price unknown.

Economic analysis of agricultural development is becoming increasingly empirical. Theory had its heyday when big decisions had to be made on scanty evidence. Gifted improvisers wove ingenious designs from meager observations to supply rationales for development programs. After further observation, questions began to be asked about the validity of some of the postulates of development theory. Were the Emperor's clothes real?

Behrman and Yotopoulos examine the premise that certain classes of farmers, characterized mainly by the absence from their production techniques of certain supposedly relevant forms of capital, are inherently unresponsive to economic incentives. The reports of these examinations are as interesting for the handling of data problems as for the findings.

The to-do about the profit maximizing question may have reached its peak. But a great deal remains to be done in quantifying supply responses. On this front, economists face a continuing struggle with data problems. The rising level of econometric sophistication imposes frightful data demands, qualitatively and quantitatively. The would-be student of economic processes in societies which have heretofore devoted few resources to the care and feeding of econometricians may be confronted by a nearly complete lack of data, or by masses of data of dubious quality. One can always collect fresh data, as Yotopoulos did, interviewing farmers in the Greek province of Epirus. Or, if the data are abundant, as in Thailand, one might hypothesize that suitable analytical procedures might still extract considerable significant information despite the presence of lots of noise.

Yotopoulos fitted Cobb-Douglas functions to input-output data for one year's activity on 435 farms. He concludes that, ". . . an admirable harmony between marginal productivities and opportunity costs graces the peasant agriculture." His discussion emphasizes how extensively Cobb-Douglas production function analysis depends on assumptions—I counted 96 statements of postulates and assumptions. Many of these need further testing to determine how critical they are for valid conclusions. For instance, what degree of heterogeneity can be tolerated in the output and input variables? Yotopoulos has contributed some innovations in measurement of capital inputs, reported in an article in this Journal, May, 1967, p. 476, and a chapter in *Economic Analysis and Economic Policy*, reviewed in this Journal, February, 1969, p. 225.

Behrman's book is a substantially revised version of his Ph.D. thesis, which received the American Farm Economic Association Award of Merit for outstanding doctoral dissertations of 1966. It presents nonlinear estimates of a Nerlovian dynamic total supply model for each of the four major Thai annual crops (rice, corn, cassava and kenaf) at the *changwad* (district) level of aggregation. The work is tediously thorough with respect to methodology, presentation of institutional and physical backgrounds, and interpretation of results. The thoroughness extends to a bibliography of more than 300 items, covering theory, methodology, and sources of the facts about Thailand. Behrman's principal result: ". . . . in the short run, farmers in underdeveloped countries respond rationally and substantially to economic incentives." This still leaves the question that Behrman poses but disclaims having tried to answer, "What are the problems that retard the long-run transformation of traditional agriculture?"

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Kneese, Allen V., and Blair T. Bower, *Managing Water Quality: Economics, Technology, Institutions,* Baltimore, The Johns Hopkins Press for Resources for the Future, 1968, x + 328 pp. ($8.95)

Davis, Robert K., *The Range of Choice in Water Management, A Study of Dissolved Oxygen in the Potomac Estuary,* Baltimore, The Johns Hopkins Press for Resources for the Future, 1968, xvii + 196 pp. ($7.00)

Although containing valuable technical materials, these are primarily books on public policy and institutions for water quality management. Their plea is for a policy and an administrative framework that will examine the full range of existing and prospective technologies to build efficient programs.

Managing Water Quality is a revised and expanded version of *The Economics of Regional Water Quality Management,* written by Kneese and published in 1964. That book had considerable impact among economists and government officials in this field.[1] Like its predecessor, the current volume begins with the physical aspects of water quality and proceeds to apply some of the basic concepts of welfare economics to the problem of waste discharge into rivers, lakes, and estuaries. As in the earlier volume, the analysis is expanded to cover regional water quality management, which combines individual and collective action in managing water quality. This is followed by case studies of a number of public efforts in managing water quality. Finally, the authors discuss the authorities a regional agency requires for effective action, as well as the role of federal, state, and local governments.

New in the present work are summary reports of research on the efficiency of alternative water quality management approaches in the Potomac and Delaware estuaries. The report and evaluation of the activities in the Ruhr area of West Germany is retained. A new chapter gives a necessarily tentative description and evaluation of public approaches to water quality management for three countries in Western Europe and for the Delaware River basin. The discussion of combined individual and collective measures has been supplemented by a rather formidable mathematical appendix, by J. Hayden Boyd. Other portions of the book were in part rewritten, reorganized, considerably expanded, and updated, but are basically similar to the earlier work. The style is lucid, and the economic arguments, while rigorously developed, are mostly based on straightforward logic and graphic analysis.

One of the principal arguments of the book remains that the externalities embodied in the discharge of waste materials can be internalized by effluent fees. These should be set at a level that will equalize the marginal costs of further waste reduction with the marginal downstream damages caused by the particular quantity of waste discharged. The authors build a strong case for effluent fees as being more conductive to efficient solutions to water quality problems than direct regulation of waste flows or public subsidies for treatment of wastes.

It is to the authors' credit that they do not gloss over the problems of setting effluent fees. These are several, but in this reviewer's opinion one of the more difficult occurs when there are non-linear or interdependent effects from the discharge of wastes. Here it would be difficult indeed to set effluent fees equal to marginal downstream damages, since the marginal damages would depend on the overall response to effluent fees and level of treatment by all waste dischargers. Similar is the case where the optimal level of collective water quality improvement measures, installed by a public authority, depends on the level of treatment that effluent fees elicit from individual waste dischargers, a problem that perhaps should have received more attention. It would seem that both of these problems suggest an approach in which waste reduction and effluent fees are negotiated between major waste dischargers and the public authority.

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[1] Reviewed in this Journal by Irving Hoch in the November 1965 issue (47:1034–1036).

Despite these problems, the case for effluent fees is a strong one. As the authors recognize, it may not be possible to nicely balance the costs of waste abatement with the costs of waste discharge, but effluent fees would be a step in that direction as well as a source of public revenues.

It would be wrong to leave the impression that this book is merely an argument for adoption of effluent fees. It is a searching and well documented review of the multi-faceted aspects of water quality management and, like its predecessor, will have considerable impact on the thinking of economists, administrators, and policy makers in this field.

In *The Range of Choice in Water Management,* by Robert K. Davis, we have a challenging reconnaissance study. It is a good sequel to *Managing Water Quality* in that it shows by empirical study the direction in which we must go if we are to have rational water quality management. The book follows the path of systems analysis, employs computer simulation of water quality control works, and follows through with the broad institutional and political implications of the results.

As reported in the first part of the book, when the Corps of U. S. Army Engineers worked on a comprehensive plan for the Potomac in the late 1950 and early 1960 decades, the generally accepted means of water quality improvement were (and still are) treatment of waste effluents and augmentation of river flow during critical periods. Alternatives were considered but precluded, either because of costs, or, as in the case of pricing of water to limit use, because there was no clear authority for implementation.

In Part II, Davis focuses on the Potomac Estuary and the objective of maintaining dissolved oxygen at specified levels. First we learn that the vital model connecting waste discharge to oxygen level used by the engineers, though the best then available, has since been, in the author's view, superseded by a superior formulation. Next in this picture of fast breaking technology, several alternative methods of water quality control are introduced. A number of these are either in limited current use or in the experimental stage. Their costs were estimated by special engineering studies in support of the book. The costs of achieving 4 milligrams per liter dissolved oxygen is explored by systematically sampling the alternatives. These range from about 30 million dollars or less for systems relying on a combination of river flow augmentation, artificial reoxygenation of the estuary, and advanced waste treatment, to over 100 million dollars for the more costly alternatives among which are those that place sole reliance on flow augmentation and conventional waste effluent treatment. The general range of costs and ordering of systems by costs, while modified, is not drastically affected by changing from the earlier to the more recent model of dissolved oxygen levels. As would be expected, the marginal costs of successively higher oxygen levels are found to be much lower for the more economical control systems. Frequencies of system failures were reported for alternative reservoir capacities. The results (in addition to showing that the Corps plan held up quite well on this score, despite the use of a new dissolved oxygen model) give some insight into the costs of alternative goals when these are stated in frequencies of failure to achieve them.

This part of the book is buttressed by four well written and very candid appendices: one on water quality models, by Leo J. Hetling; the second on waste control processes, by Robert K. Davis; the third on reservoir system simulation, by Robert M. Steinberg; and the fourth on synthetic hydrology, by Nicholas C. Matalas. These are fine introductions for the technical student of the field. In both supporting materials and main text, a quality of freshness and excitement comes through to the reader. It is said in their praise rather than in their condemnation that these materials underscore how little we really know about this business and how vulnerable are the best assumptions. Despite this, it is this reviewer's judgment that the general orientation of the main conclusions hold up. There are promising new methods of water quality management and of systems analysis that deserve serious consideration.

Part III of the book summarizes the implications of the technical analysis. In the author's words, this comes to the problem of "widening the range of choice." It is suggested that a planning agency, rather than coming up with a complete plan as its first and final product, should first reconnoiter the costs of achieving alternative (and usually monetarily non-quantifiable) goals through a broad range of alternatives. Before the planning becomes committed to any approach, the more promising courses of action and kinds of authorities needed would be presented to public bodies. The choices would be narrowed and refined through successive iterations of interplay between the planners, the public, the researchers, and the operators of water systems. The final plea is for politicians in the best sense of the word—policy makers who will grasp the choices before them and make the decisions needed for rational planning.

Both books indicate how much further science has progressed in other fields related to water than in this area of policy and institutions.

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Koo, Anthony Y. C., ***The Role of Land Reform in Economic Development: A Case Study of Taiwan***, **New York, Frederick A. Praeger Publishers, 1968, xvii – 197 pp. ($12.50)**

True to its title, this book is about the land reform experience of Taiwan and the role of that reform in Taiwan's economic development. After a brief review of the Japanese influence on Taiwan's development from 1895–1945, the author outlines the major steps in the land reform carried out during the period 1949–1953: farmland rent reduction, sale of public land, and land to the tiller. The relative income positions of operating farmers pre- and post-reform and the changes in agricultural productivity are analyzed. The author then attempts to measure (not too successfully in my view) intersectoral capital transfers and devotes one chapter to a discussion of unemployment in the farm sector and labor transfers from agriculture. In the final analytical chapter, the author looks in a general way at the direct costs and the opportunity costs of land reform.

The author concludes that the impact of land reform on Taiwan's economy was "both immediate and far reaching" (p. 123). Especially significant were increases in agricultural productivity which accompanied the reform. The author finds no evidence that land reform in the late 1940's competed significantly with industrial development. It "exerted little strain on the balance of payments. In short, the opportunity cost of land reform and agricultural development was minimal" (p. 124). In fact, "land reform contributed to the industrial development of Taiwan" (p. 124) through supply-demand interrelations, and especially through the "utilization of incremental income on the part of farmers to educate their children" (p. 124).

This is an informative book, but not an exciting one; it breaks no new ground. For the reader unacquainted with other literature on Taiwan's development and land reform, this work provides a useful overview of the process and an attempted economic evaluation of this experience. Yet, for my money, I'll take Raymond Christensen's 90-page USDA bulletin in preference to this $12.50 Praeger edition [1].

There are several troublesome, though minor, aspects. Readability would be much improved by a thorough editing. On page one, in the very first paragraph, the author states: "For example, in Thailand, India, and the Philippines, the agricultural population is 82.74, and 61 percent, respectively, of the economically active total in the 1960's." How shall we interpret such a statement? Careless wording (and/or omissions) of this kind and errors (e.g., p. 17, 67.2 percent should be 672 percent; pp. 78-79, the text refers to years 1914–19 but Table 20 refers to 1914–17; p. 103, the number 189 in Table 27 should be 191; etc.) detract from the analysis. One expects a more careful job in a book selling for $12.50.

But these are, after all, petty annoyances. The book has one major analytical problem, however. In Chapter 6, the author estimates the intersectoral flow of savings and concludes that "there was a flow of savings from the nonagricultural to the agricultural sector in the 1950's in Taiwan" (p. 87). "Direct contribution of agriculture to financing the growth of products of the nonagricultural sector was nil, if not negative, immediately following the land reform. . . . The net flow of surplus from the agricultural to the nonagricultural sector did not come about until in the late 1950's and early 1960's" (p. 90).

These statements contradict the findings reported by Christensen [1] based on work by T. H. Lee [2], and also the more recent work by Lee on these issues [3]. Since intersectoral transfer of capital is such a critical question in the theory of economic development, Lee's major conclusions are summarized here.

Lee's review covers the period 1895–1960. He distinguishes between financial, or visible, flows and invisible flows—the latter resulting from changes in the terms of trade. Financially, transfers through land rent payments and government taxation were most important in the pre-World War II period, while transfers in the form of farmers' savings became increasingly important in the post-war period. Conversely, invisible real net capital outflows brought about by terms of trade unfavorable to agriculture were less important in the pre-war period but accounted for more than 50 percent of the total outflow in the post-war years. Throughout the entire period, there was a net capital outflow from Taiwan's agricultural sector. The magnitude of this outflow showed a roughly increasing trend until near the end of the period [3, p. 40].

Why such contradictory conclusions? The major factor seems to be the exclusion or inclusion of transfers resulting from changes in the terms of trade between agricultural products and other products. Koo shows (p. 80) that the price index of agricultural products, relative to all commodities, dropped sharply in the decade 1951–60. "The fact suggests that the agricultural sector's contribution to the nonagricultural sector is more than that indicated by the amount of transfers estimated in the following sections of the present chapter" (p. 80). Yet he later ignores this caveat in drawing conclusions about net intersectoral capital transfers. Lee, on the other hand, points out that "In the post-war period . . . the contribution of real visible capital flow from agriculture to total capital formation was not large, but the real invisible capital outflow was large. The squeeze on agriculture through the low agricultural price policy was obviously great" [3, p. 37].

Koo's more restricted measure of capital flow is roughly consistent with the data on the same measure presented by Lee. But his failure to incorporate the terms of trade component leads to an erroneous conclusion with respect to *total* transfers.

Yet, in fairness to Mr. Koo, it must be noted that the analysis of intersectoral transfers is an extremely complicated undertaking—both conceptually and empirically. Thus, our judgment of his book should not hinge on this one question alone. I chose to highlight this issue because it seems to be central to the formulation of agricultural development policies.

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Mellor, John W., Thomas F. Weaver, Uma J. Lele, and Sheldon R. Simon, ***Developing Rural India: Plan and Practice, Ithaca, Cornell University Press, 1968,*** **xxi + 441 pp. ($10.00)**

India is almost an unlimited source of data and experience in development. Its large area, diverse geographical characteristics, and enormous population, the great local variations in the social, cultural, and historical, as well as economic factors that affect development, and its obsession with documentation, all combine to present endless material for both case and more general studies from almost any point of view. The present book reflects, probably as well as a single fairly brief treatment can, the situation after fifteen years of Indian experimentation with planned development of agriculture. It is divided into five parts.

Part I (Mellor, 143 pages) summarizes the problems of agricultural development within the overall economic and historical situation and outlines quite effectively the objectives set by Indian planners, their successes and failures both in planning and implementation, and the status of agriculture at the end of the Third Five Year Plan in 1966. It presents also a brief, but essentially correct, survey of the lessons drawn from the 1951–1966 effort, leaving for Part V the recommendations for future activity based upon these lessons.

Part II (Weaver, 94 pages) goes in considerable depth into the production problems of rice and wheat farmers in Raipur District in Madhya Pradesh State. Since water is so basic a factor in rice production, he devotes considerable space to its management and to irrigation-system design. Against a brief historical background sketch, he outlines the evolution of land tenure and revenue, the caste system and its increasingly rapid breakdown, as well as its favorable and unfavorable implications for agricultural development, and summarizes weather, soils, and irrigation practices. He traces the history of the district as a fairly typical microcosm of India's approach to rice production as to land tenure, irrigation practices, water problems, research, and technological improvement, and stresses that social and cultural factors must be taken into account whenever technical production facilities and/or practices are to be changed. This was sharply demonstrated by the limited success of the Ford Foundation Package Plan for farm production improvement, which was applied to Raipur beginning in 1961. 1966 results indicate that local soil and climate factors reduced the effectiveness of new rice strains and cultivation methods and that traditionally evolved rice production techniques have many merits not previously appreciated by outsiders. Weaver brings into sharp focus the various elements of change required to improve production in Raipur, with implications that local factors may be of similar though varying importance in other parts of India. His analysis of water management needs in Chapter 10, and the summary in Chapter 11, are especially systematic and useful.

Part III (Lele, 60 pages) analyzes the traditional market structure for grain sorghum in the most important district, Sholapur, in Maharashtra State in West India; special attention is given to its effect on price spread, to the extent that it permits monopoly, and to ranges of and reasons for price variation. The study outlines very clearly the complex but well integrated wholesale and retail market operations in the district, finds and accounts for quite a high degree of competition at both levels, and explores the relations between market information, transportation and storage and speculation, among other factors, and price trends. This section might be improved by a summary, but brings together in a very compact, clear fashion what appear to be all the major factors at work in this market situation.

Part IV (Simon, 46 pages) describes a village, Senapur in northeast India, which is strongly affected economically by demand of the steel plant at nearby Bhilai both for labor and for agricultural products. Relations are traced between income levels and sources, between market development and consumption patterns, and agricultural production and investment. Here again no summary is provided, and a number of implicit conclusions are not clearly drawn—perhaps most important, that increase in agricultural output through heightened investment may be economically unjustified. However, to the extent that Senapur is typical, light is shed from new angles on these aspects of India's agricultural problems to round out usefully the descriptive and analytical parts of the book.

Part V (Mellor, 34 pages) lists problems, outlines prospects, and draws major lessons that emerge from the earlier four parts. Too brief for much detail, it nonetheless touches succinctly on key errors of the past and remedies needed for the future. There is room for skepticism regarding the annual 4.5 percent growth rate forecast for agricultural production; but the assumptions underlying it are clearly stated and can be evaluated one by one to arrive at a given reader's revised estimate. The list of errors may fail to consider adequately the built-in social, psychological, and organizational handicaps that impede the whole development program in India, remedies for which receive scant mention here. Some of the "lessons" are inevitably oversimplified. But these are quibbles.

The total thrust of the book is informative, thought-provoking and action oriented, and the comprehensive overview it affords of the agricultural development situation in India will prove valuable to anyone with a general interest in India or concerned with development of agriculture elsewhere.

The work is clarified by appropriate and well-prepared tables, illustrated by numerous clear and suitable graphs, and supported by one of the most complete, though still selective, bibliographies I have seen. Name and subject indexes, while limited, appear useful.

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Papanek, Gustav F., ed., *Development Policy—Theory and Practice*, Cambridge, Harvard University Press, 1968, xvi + 367 pp. ($12.50)

The volume is an outgrowth of the practical technical assistance experience in six developing nations of the Harvard Development Advisory Service. It consists of a collection of eleven essays on various aspects of development planning and stabilization policy. The papers are fairly academic in style and content.

There are three papers which are econometric in nature (by Wouter Tims, by Alfred Conrad, and by Geoffrey Maynard and Willy Van Rijckeghem). Of these the most interesting is by Maynard and Van Rijckeghem who construct an econometric model to explain price level fluctuations. The Wouter Tims consistency I-O model for Pakistan, while undoubtedly carefully constructed and of great practical value to Pakistan's development planning, contains nothing new. After a cogent argument concerning the use of development models, the Conrad model for Liberia appears to be an afterthought. Two other papers, by Dunkerley and by Mallon, deal with exchange rate policy in Colombia and Argentina, respectively. Both are detailed analyses of specific exchange rate, tariff and subsidy arrangements and read much like IML or IBRD reports. The same is true of Bird's contribution on sales taxes in Colombia. The outstanding paper in the collection is that by David Felix on reasons for the failure of the import substitution policy in Latin America. It brings the best analytic tradition to bear upon an important empirical phenomenon, and shows that, far from being an unexpected result, the eventual exhaustion of import substitution as an engine of growth is inherent in the economics of the phenomenon. The substantive portion of the volume concludes with sectoral analyses, on Pakistanian agriculture by Falcon and Gotsch, and on wage policy in Liberia by Weckstein, and a retrospective by Papanek.

On the whole, the collection is rather disappointing. The by now standard two-gap model is the predominant theoretical framework underlying the analyses in this book. The empirical models are standard, too, and have been surpassed in other equally practical applications, for example, Eckaus and Parikh on India [1] and the papers on planning in the Adelman-Thorbecke volume [2]. If one is to judge by the present collection, the prolonged confrontation of well-trained academicians with the problems that arise in the course of policy formulation in developing countries has added very few new insights to the knowledge of development processes. This conclusion is reinforced by Papanek's essay in which he tries to address himself to the question: What have we learned from the fifteen years of practical involvement with development planning? Judging by Papanek's article, the answer appears to be a disappointing series of common-place generalizations.

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President's National Advisory Commission on Rural Poverty, *Rural Poverty in the United States,* Washington, D.C., Government Printing Office, 1968, 601 pp. ($5.75)

This volume contains thirty-two background papers prepared for the President's Commission on Rural Poverty. Another eighteen unpublished papers are listed on the last page. The papers are grouped around the following subjects: Part I, Rural People and Their Communities; Part II, Mobility and Migration; Part III, Health and Family Planning; Part IV, Agriculture and Natural Resources; and Part V, Economics of Poverty.

Readers should not expect to find in this volume the substantive basis for all of the Commission's report, *The People Left Behind.* Only a few of these background papers were cited in the report, along with many other published sources. Much of the report also involves judgments and policy choices that are not subject to empirical validation.

The studies presented in this volume, however, are of scholarly interest in themselves. The staff directors, C. E. Bishop and George L. Wilber, are to be thanked for making these studies available in published form. Unfortunately, the "Table of Contents" lists the papers without naming the authors, many of whom are quite prominent in their fields.

Readers with widely different interests will find certain articles to be of special interest; therefore, only a lengthy summary could do this volume justice. In a brief space, any comments by this reviewer must be highly selective and personal.

The overall impression left by these studies, when closely compared with the report, is disturbing. Much of the work seems to have been done to count and describe the "people left behind." There is little analysis of causes that would suggest solutions to the problem of rural poverty. Most of the message that comes through is a generalized plea for a greater rural share of social welfare spending.

The article by Hyman P. Minsky, for example, pessimistically concludes that a full employment policy leads only to speculative over-investment causing inflation, while adequate monetary restraint must be accompanied by government support of employment as the employer-of-last-resort. This finding corresponds to the report's advocacy of some kind of federal job guarantee to accompany a universal minimum wage. Varden Fuller's article on hired farm labor also ends with a plea for minimum wages, although G. Edward Schuh's earlier article provides empirical estimates of the elasticities of demand and supply of farm labor. These suggest that minimums will frustrate more workers looking for jobs that are not there. The articles on health needs in rural areas suggest merely that more national supply of health manpower is needed, along with some construction of regional centers of rural health services. More credit and subsidy for rural housing, as well as a raising of welfare benefits for the elderly, are suggested to supplement rural living standards. James T. Bonnen's article shows that existing farm price support programs have not distributed benefits proportionately to low-income farmers; and even the defense of agricultural programs by Vernon C. McKee and Lee M. Day fails to show that the bulk of expenditures reduces interstate inequalities.

A thread of analysis of the labor market in a few articles, however, does seem to shed some light on needed public programs that might solve the problem. The articles by G. Edward Schuh and Rex F. Daly present the problem of slowly rising agricultural demand and rapid improvements in productivity. Several decades of high rural outmigration have reduced farm labor and population, but apparently not enough. Several descriptive articles reveal the resulting structure of low incomes: a high proportion of dependents (young and old), limited jobs for women, underemployment of males, and a deficiency of public facilities and services.

Why hasn't adjustment through outmigration provided a solution? The article by Dale E. Hathaway and Brian E. Perkins suggests how the "mobility process works less well for those who need it the most.' Mobility rates are lower for Negroes, older workers, small farm operators, low-income areas, and remote areas. Long-distance migration is mostly by the young and Southern Negroes, but there is little evidence that long distance pays greater dividends. More than 40 percent of those taking nonfarm jobs earned less in their first year, and with adverse earning experience they tend to return to farming. Return migration can amount to as much as 90 percent of outmigration.

What is needed to break out of this vicious cycle? The article by Donald Schon suggests that the greatest problem in initiating and directing migration is inadequate information on job opportunities. Then, housing shortages in urban areas cause much of the difficulty of urban assimilation. Previous inadequacy of education, several of the articles indicate, limits the urban job opportunities and earnings of rural migrants. The article by John F. Kain and Joseph J. Persky suggests that migration from rural areas only worsens the rural slums problems of major metropolitan areas; so they advocate more industrial development in the rural South. Hathaway and Perkins also suggest that most persons who leave farming take local jobs, if available, and that they fare better when near large cities.

All of this suggests a priority for public policies of subsidy to rural areas in education and industrial development. Kain and Persky warn that equal opportunity for Negroes must accompany aid to education and job development; and they argue that, contrary to E.D.A. policy, new industry should be allowed to seek the most efficient locations within the region. Anne O. Krueger's article, in fact, shows faster-than-average urban growth in cities with over 50,000 population. And Wilbur R. Maki's article suggests that public investments in community infra-structure is only a necessary, not a sufficient, condition of industrial growth.

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Schultz, Theodore W., *Economic Growth and Agriculture*, New York, McGraw-Hill, 1968, x + 306 pp. ($9.95)

This book would have been better titled "Selected Essays by Theodore Schultz on the Economic Development of Agriculture." It is an uneven collection of 32 items that appeared from 1956 to 1967, ranging from book reviews and discussants' comments of conference papers on the one hand, to journal articles and chapters from books on the other. (A little over half are as recent as 1966 and 1967.) They all deal with some facet (or facets) of economic growth in the agricultural sector, but as a group they conspicuously neglect the relationships between the agricultural sector and other sectors, and what ground they do cover is not covered systematically.

It is a worthwhile book if for no other reason than that it makes readily available a number of widely scattered items, many of which originally appeared in relatively inaccessable publications. But—probably because many of the contributions were originally conference papers or statements made to policy makers—this volume is rarely Schultz at his best. The bulk of the papers are more provocative than convincing; they often do not fit well together; there is considerable overlapping; there is at times confusion between conditions and problems of agriculture in developed and developing countries; and discussion of specific developing economies is limited mainly to two countries in Latin America, Chile and Mexico.

Schultz writes well, but to forge a chapter simply by hinging together two or more papers written at different times for different audiences makes for tedious reading. For example, the bulk of Chapter 3 is on land as a factor of production but shifts abruptly, without warning or explanation, into two pages that originally appeared as Schultz's side of a debate with C. V. Plath. Here, as elsewhere, when portions of a debate are reprinted, the effect is like overhearing a phone convrsation—the reader gets only Schultz's half of the argument. It would have been helpful to have the other half also reproduced—perhaps in an appendix. The chapter ends with what was originally a review of Ester Boserup's *The Conditions of Agricultural Growth* (London, 1965), presented without any attempt to say how it relates to the preceding debate with Plath or the other topics in the chapter.

Chapers 2 and 4 both deal with population. Chapters 2, 4, 5, 6, 8, 10, and 11 deal largely with the United States and focus mainly on poverty, human capital, and agricultural research. Chapter 9 touches on selected aspects of agricultural development in Latin America. Chapter 12 is Schultz's criticism of two papers on theory related to agricultural growth, one by John Mellor and the other by Kazushi Ohkawa. Neither paper is reprinted, and because Schultz sometimes fails to spell out clearly the positions with which he is taking issue, it is impossible to make sense of much of what he has to say without a trip to the library.

The reader who can force himself to wade through the repetition will find a good deal of food for thought but will be frequently distracted by a carelessness in presentation of evidence that is at times unforgivable. Schultz quotes W. Arthur Lewis on the lack of response of African farmers to economic incentives and correctly criticizes him (p. 5) without a hint as to which of Lewis' voluminous and far flung writings the quote is from—and without citing any of the evidence that is damaging to Lewis' position. At other points, without bothering to show a shred of evidence, Schultz boldly asserts that in the years ahead "the endowment of natural resources in most countries will not prove to be a limitational factor to large increases in agricultural production" (p. 7); that "countries producing food grains, predominantly wheat and rice, for export will see the demand for such exports weaken substantially from what it has been in recent years" (p. 8); and that, in developing countries, we have "started with extension programs before there was anything worthwhile to extend to farmers" (p. 13). In discussing problems of developing countries, he makes international comparisons of levels of living in Latin America without explaining the criterion (or criteria) for placing a country in the "very poor" group as opposed to "not nearly so poor" or "comparatively well to do" (pp. 193–94). Yet he asserts, without qualification, that the "very poor" are "about as poor as countries anywhere" (p. 194).

Some of the contributions are excellent throughout. The last half of Chapter 7 is his paper on efficient allocation of scientists presented at the 1967 meetings of the American Agricultural Economics Association at Guelph and is carefully reasoned, with penetrating insights. Chapter 8, devoted to human capital, is an important contribution in an area where his pioneering work has done much to change some of our concepts about the process of economic development.

There is an index, but it is woefully inadequate, being not nearly detailed enough and completely failing to list a number of important topics that show up in the text (e.g., terms of trade, pp. 13, 15, and 101; disguised unemployment, pp. 202–205; supply response of farmers, pp. 13, 34, 39, and 220; and agricultural surpluses, pp. 23 and 25).

Although disappointingly marred in places by carelessness and the way in which they were packaged, a number of the papers in this collection are stimulating and still timely. We can be grateful that we now have them together under hard cover.

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Trant, Gerald I., David L. MacFarlane, and Lewis A. Fischer, *Trade Liberalization and Canadian Agriculture*, Toronto, University of Toronto Press, 1968, 119 pp. ($3.50)

In 1965 the Private Planning Association of Canada initiated a series of studies to explore the implications to Canada of trade liberalization among the nations bordering on the North Atlantic. Of about a dozen publications covering six major sectors and a number of policy considerations, one publication was devoted to agriculture. This volume consists of two monographs written quite independently by G. I. Trant and by MacFarlane and Fischer.

Trant's 68-page study, "The impact of trade liberalization on Canadian agriculture," examines the likely effects on the production, trade, and prices of almost all Canadian farm products if barriers to trade were to be eliminated among the countries bordering on the North Atlantic. Although not specifically stated by the author, he seems to have assumed also that certain government subsidies and controls would be reduced. Thus, he posits relaxation of production controls on tobacco in Canada and the United States and elimination of the Canadian subsidy on sugar beets, but he is not explicit about such vital assumptions as the maintenance of the wheat acreage allotment program in the United States or deficiency payments programs in any of the countries discussed. He does make a blanket and very vague assumption (p. 1) "that intranational institutional arrangements will remain relatively unchanged," but what this means in the case of individual commodities is unclear.

Trant's theoretical concepts provide a second problem for the reader. He confuses comparative advantage and absolute advantage in his introduction, citing a more rapid increase in "agricultural productivity" in Canada than in the United States as evidence that "Canada's comparative advantage in agriculture has improved relative to that of the United States . . ." (p. 5). Absolute advantage is sometimes found by comparing current farm price levels in different countries and sometimes by estimating opportunity costs in Canada but not in other countries.

In spite of these serious criticisms, the main body of Trant's study provides a remarkable concentration of well-chosen data, institutional and policy descriptions, and insight. This study would make useful introductory reading for anyone concerned with Canadian agriculture and policy, especially on a commodity-by-commodity basis.

The second monograph "Prospects for trade liberalization in agriculture," by MacFarlane and Fischer, is a 50-page rather discursive discussion of agricultural policies and developments in North Atlantic countries. The authors differ with Trant, maintaining that "Canada's comparative-advantage position has clearly worsened over the past ten years" (p. 113), giving as sole proof what they call "the most striking evidence" that Canada is now in an agricultural trade deficit position vis-à-vis the United States.

A criticism common to both papers is that they have attempted far too much, but Trant's well documented treatment of every major farm commodity produced in Canada will remain a useful first reference for some time.

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Williams, D. B., ed., *Agriculture in the Australian Economy*, Sydney, Sydney University Press, 1967, xvii + 349 pp. ($6.00)

These essays were distributed to conferees of the International Association of Agricultural Economists at its 13th conference, held in Sydney, New South Wales, Australia, in 1967. They are designed to acquaint the reader with principal features of Australian agriculture, together with its opportunities and problems, past, present and future. This purpose is accomplished in a manner to attract wide readership among the many interested in this fascinating corner of the world. The collection is well balanced in terms of relevant topics and displays the considerable talent available in the community of Australian agricultural economists. Yet the volume seldom is so technical as to tax even the most general reader.

That development is the name of the game in Australia is revealed by the content of the volume to a greater extent than may have been intended by the individual contributors. The time path of development—past, contemporary, and future—is related by Shaw, Hooke, and Hoffman, respectively. Ecological influences on development are described by Davidson and Donald in terms, respectively, of land-use response to climate and markets and of innovational adaptations to the Australian physical environment. Many Americans in Canada and the United States feel a cultural kinship with Australians. These chapters will help to explain differences in development patterns and current structure.

Nor is the organizational infrastructure overlooked. Druce outlines the organization of research, education, and public service facilities, relating them to the political organization of the country. We are reminded here of Australia's youth as a nation. The colonies were federated into the present six states (and a Commonwealth territory) in 1901. Chislett outlines the impressive array of organizations founded in its brief history to represent groups of farmers and graziers. Many in Canada and the United States will recognize the tendencies to group around commodity and other interest groups.

Essentially the same size as continental United States, Australia contains but slightly more than 11 million persons. However, it is among the most urbanized countries of the world—and among the most isolated. Hence the relation of markets to development is of special importance. Sixty percent of Australia's agricultural production is exported, contributing three-fourths of Australia's foreign exchange. Over 90 percent of Australian wool is exported, accounting for half the wool in world trade. Australia is second only to the United States in agricultural exports and is 13th in terms of total exports.

McKay and Harris outline current problems in Australia's world trade, discussing current changes in relations with trading partners, with appropriate emphasis on the United Kingdom, United States, and Japan. Competent discussions of supply and demand for Australian farm products are provided by Gruen, Ward, and Powell, and by Gruen and McLaren. In the latter, Australian diets are compared with those of other selected countries. Parish outlines and analyzes the marketing methods and instruments evolved to counter marketing peculiarities generated by the Australian environment.

Resource endowments and policies related to their use are discussed by Campbell (land), Schapper (labor), Jarrett (capital and credit) and Lewis (price policies). Australian agriculture is featured by extensive use of land, by capital intensity, and by high cost of labor. On the whole, farms are large in physical size and produce incomes essentially equal to non-farm incomes on the average, though they vary substantially more over time than do non-farm incomes. Income disparities are found (e.g. in small-farm dairying) but are relatively rare compared with most other advanced countries.

Minor complaints might be made. Despite the heavy emphasis given development, little analytic treatment is provided to relate agricultural growth processes to national economic growth. Nor are there references to imaginative uses, available in Australian literature, of input-output models. These would have helped remedy a general deficiency in intersector analysis. To encourage investment, and hence growth, capital gains are exempted from Australian taxation. Analysis of the allocative and equity effects, comparable (say) with Parish's analysis of market instruments, would have been a useful addition.

The visitor to Australia invariably is impressed with two features: the world's oldest landscape and the oldest surviving human population. The former is reflected abuntantly in the volume. The latter receives but two brief mentions: Davidson notes that aborigines comprise over half the labor force on cattle stations of the Northern Territory and Western Australia, and Donald comments on the fact that none of the plants and animals collected and hunted by aborigines has yet been found useful in domesticated species. (They don't survive competition with introduced species in the presence of enriched fertilizer and feeding regimes.) It would have been especially interesting had Professor Schapper shared some of his observations on problems related to aborigines.

But these *are* minor complaints. The volume is a useful one and deserves a wide readership among the many interested in Australia. A warning: it may induce in the reader still a greater wanderlust in the direction of this South Pacific "island continent." However, should the bug really attack, the traveler could scarcely find, in such short compass, a more competent introduction to economic aspects of Australian agriculture. It is a useful complement to several excellent geographical, geological, and historical accounts that are already available.

CHESTER B. BAKER
University of Illinois

Books for listing in this section should be sent to the Book Review Editor (see inside front cover for address).

Books Received

Agricultural Projections for 1975 and 1985, Europe, North America, Japan, Oceania (Country Studies), Paris, Organization for Economic Cooperation and Development, 1968, 1188 pp. $16.00, £5 10 s, F64, Sw. fr. 60, DM 50. Paper.

Black, Guy, *The Application of Systems Analysis to Government Operations,* New York, Frederick A. Praeger, 1968, xiv + 186 pp. $15.00.

Bogue, Donald J., *Principles of Demography,* New York, John Wiley and Sons, Inc., 1969, xiii + 917 pp. $16.50.

Brake, John R., ed., *Farm and Personal Finance,* Danville, Illinois, The Interstate Printers & Publishers, 1968, viii + 132 pp. $2.50. Paper.

Briggs, Hilton M., *Modern Breeds of Livestock* Third Edition, New York, The Macmillan Company, 1969, xix + 714 pp. $12.95.

Brown, Lawrence, A., Diffusion *Processes and Location, A Conceptual Framework and Bibliography,* Bibliography Series Number Four, Philadelphia, Regional Science Research Institute, 1968, vii + 177 pp. Price unknown. Paper.

Carruthers, I. D., *Irrigation Development Planning—Aspects of Pakistan Experience,* Ashford, Kent, England, Department of Agricultural Economics, Wye College (University of London), 1968, 67 pp. 10 s.

Dagli, Vadilal, ed., *Foundations of Indian Agriculture,* Bombay, Vora & Co., 1968, xvi + 378 pp. $7.00.

Eckaus, Richard S., and Kirit S. Parikh, *Planning for Growth—Multisectoral, Intertemporal Models Applied to India,* Cambridge, The M.I.T. Press, 1968, xvi + 208 pp. Price unknown.

Farouk, A., *Irrigation in a Monsoon Land: Economics of Farming in the Ganges-Kobadak,* Dacca, Bureau of Economic Research, University of Dacca, 1968, iii + 169 pp. Rs. 10.

Fisher, Walter D., *Clustering and Aggregation in Economics,* Baltimore, The Johns Hopkins Press, 1969, xii + 195 pp. $10.00.

Food Goals, Future Structural Changes, and Agricultural Policy: A National Basebook, Iowa State University Center for Agricultural and Economic Development, Ames, Iowa State University Press, 1969, x + 325 pp. $5.95.

Gollnick,, Heinz, *Einfurhrung in die Okonometrie,* Stuttgart, Verlag Eugen Ulmer, 1968, 319 pp. DM 40.

Hamilton, H. R., S. E. Gladstone, J. W. Milliman, A. L. Pugh III, E. B. Roberts, and A. Zellner, *Systems Simulation for Regional Analysis—An Application to River Basin Planning,* Cambridge, The M.I.T. Press, 1969, xii + 407 pp. $15.00.

Hardin, Clifford M., ed., *Overcoming World Hunger,* Englewood Cliffs, N.J., Prentice-Hall, Inc., 1969, xi + 177 pp. $4.95 cloth, $1.95 paper.

Heath, Dwight B., Charles J. Erasmus, and Hans C. Buechler, *Land Reform and Social Revolution in Bolivia,* New York, Frederick A. Praeger, 1969, xiii + 464 pp. $18.50.

Hungary 68, (in English), Budapest, Pannonia Press, 1968, 343 pp. Price unknown.

Karaska, Gerald J., and David F. Bramhall, eds., *Locational Analysis for Manufacturing—A Selection of Readings,* Cambridge, The M.I.T. Press, 1969, xi + 515 pp. $12.50.

Kulkarni, V. G., *Statistical Outline of Indian Economy,* Bombay, Vora & Co., 1968, xii + 292 pp. $6.00.

Lancaster, Kelvin, *Introduction to Modern Microeconomics,* Chicago, Rand McNally & Company, 1969, viii + 326 pp. $8.50.

Makeham, J. P., A. N. Halter, and John L. Dillon, *Best-Bet Farm Decisions,* Armidale, N. S. W. Australia, University of New England, 1968, 69 pp. $1.50. Paper.

Montgomery, David B., and Glen L. Urban, *Management Science in Marketing,* Englewood Cliffs, Prentice-Hall, Inc., 1969, xix + 376 pp. $12.50.

O'Connor, R., and M. Breslin, *An Input-Output Analysis of the Agricultural Sector of the Irish Economy in 1964,* Dublin, The Economic and Social Research Institute, 1969, table insert and 29 pp. 5/ Paper.

Panel on Organization and Management for Agricultural Development in Latin America, Turrialba, Costa Rica, Training and Research Center of the IICA, 1968, 388 pp. Price unknown. Paper.

Papageorgiou, Euthymios, *Agricultural Economics—Farm Management,* (in Greek), University of Thessaloniki, 1967, 563 pp. Price unknown.

Perkins, Van L., *Crisis in Agriculture, The Agricultural Adjustment Administration and the New Deal, 1933,* Berkeley, University of California Press, 1969, vii + 245 pp. $6.00. Paper.

Preston, Lee E., and Constantine Tzavelas, *Consumer Goods Marketing in a Developing Economy,* Research Monograph Series 19, Athens Center of Planning and Economic Research, 1968, 274 pp. Price unknown. Paper.

Psacharopoulos, George, *The Anatomy of a Rate of Growth: The Case of Hawaii, 1950–1960,* Honolulu, Economic Research Center, University of Hawaii, 1969, 73 pp. Free.

Rogers, Everett M., and Lynne Svenning, *Modernization Among Peasants—The Impact of Communication,* New York, Holt, Rinehart and Winston, Inc., xviii + 429 pp. $6.95.

Schapsmeier, Edward L., and Fred-

erick H. Schapsmeier, *Henry A. Wallace of Iowa: The Agrarian Years, 1910–1940,* Ames, Iowa State University Press, 1969, xiii + 327 pp. $8.95.

Scitovsky, Tibor, *Money and the Balance of Payments,* Chicago, Rand McNally & Company, 1969, ix + 188 pp. $7.00.

Sewell, W. R., Blair T. Bower, ***et. al.,*** *Forecasting the Demands for Water,* Ottawa, Department of Energy, Mines and Resources, 1968, xiv + 262 pp. $1.50. Paper.

Stewart, Charles Leslie, *Land Tenure in the United States with Special Reference to Illinois.* The University of Illinois, 1916, First reprinting 1967, New York, Johnson Reprint Corporation, 135 pp. $6.00.

Stiglitz, Joseph E., and Hirofumi Uzawa, eds., *Readings in the Modern Theory of Economic Growth,* Cambridge, The M.I.T. Press, 1969, viii + 497 pp. $12.50 cloth, $7.50 paper.

Trade Yearbook, 1967, Vol. XXI, Rome, Food and Agriculture Organization of the United Nations, 1968, xiii + 464 pp. $6.00 or 48 s or FF 30.00.

Vakil, C. N., and G. Raghava Rao, *Economic Relations Between India and Pakistan,* Bombay, Vora & Co., 1968, viii + 214 pp. $5.00.

Venkateswaran, R. J., *The Tragedy of Indian Rupee,* Bombay, Vora & Co., 1968, ix + 131 pp. $2.50.

The Virus Diseases of the Rice Plant, Proceedings of a Symposium at The International Rice Research Institute, April 1967, Baltimore, The Johns Hopkins Press, 1969, xiii + 354 pp. $15.00.

Viser, Festus Justin, ed., *The U.S.S.R. in Today's World,* M. L. Seidman Town Hall Lectures, Memphis, Memphis State University Press, 1969, xi + 73 pp. $2.50.

Williams, D. B., ed., *Agriculture in the Australian Economy,* Sydney, Sydney University Press, 1967, xvii + 349 pp. $6.00.

Wrage, Helgi H. Robert, *Englands Agrarpolitik Zwischen Commonwealth and Europa,* Hamburg, Verlag Paul Parey, 1969, 77 pp. 16.80 DM.

Announcements

WINTER MEETING
AMERICAN AGRICULTURAL ECONOMICS ASSOCIATION WITH ALLIED SOCIAL SCIENCE ASSOCIATIONS

December 27–30, 1969, New York

The winter meeting of the American Agricultural Economics Association will be held in conjunction with the Allied Social Science meetings in New York City, December 27–30, 1969.

The program is as follows:

Sunday, December 28	
Macro-Simulation Models	Chairman, George Judge, University of Illinois (Joint program with Econometrics Society)
Monday, December 29	
Current Economic Policy—Its Appropriateness and Effectiveness—A panel discussion with audience participation	Panel: Walter Heller, Department of Economics, University of Minnesota; Henry Wallich, Department of Economics, Yale University; John Schnittker, Department of Economics, Kansas State University; D. Gale Johnson, Department of Economics, University of Chicago (Joint Session with American Economics Association)
Monday, December 29	
AAEA Luncheon	Members are urged to get tickets to this event immediately upon their arrival.
Tuesday, December 30	
Meeting the Changing Need for Agricultural Statistics	Chairman, Joseph Ackerman, Farm Foundation Participants to be announced.

1970 ANNUAL MEETING

The 1970 annual meeting of the American Agricultural Economics Association will be held in Columbia, Missouri, August 9-12, 1970. The meeting will be a week earlier than usual to avoid conflict with the meeting of the International Association of Agricultural Economists. Please send program suggestions to Dale E. Hathway, Department of Agricultural Economics, Michigan State University, East Lansing, Michigan.

JOURNAL OF LEISURE RESEARCH

The National Recreation and Park Association announces publication of the *Journal of Leisure Research,* a new venture launched in response to a pressing need for the communication of comprehensive information on leisure research. To be published quarterly, beginning with Winter (January) 1969, the Journal will disseminate research findings in the social and natural sciences related to leisure. It is conceived as an interdisciplinary research reference to alert professionals to innovative research methods and significant data to meet the challenges of the future and will reflect consideration of the multitudinous forces that influence leisure trends and behavior patterns. Contributions are encouraged from researchers engaged in relevant studies. Scholarly articles, research notes, book reviews, and communications are welcomed for publication review. Address manuscripts, correspondence, and subscription inquiries to the Editor, *Journal of Leisure Research,* National Recreation and Park Association, 1700 Pennsylvania Avenue, N.W., Washington, D.C. 20006.

AAEA DUES

Dues for 1969 are payable. The dues rates are as follows:

Regular membership	$10.00
Junior membership (graduate students, 3-year maximum)	5.00

Please mail your check, payable to the American Agricultural Economics Association or AAEA, to C. D. Kearl, Secretary-Treasurer, AAEA, Department of Agricultural Economics, Cornell University, Ithaca, New York 14850.

WESTERN AGRICULTURAL ECONOMICS ASSOCIATION

The annual dues rates are as follows:

Regular membership	$3.50
Student membership (with student status certified by department)	1.00

Mail application and check to Leo R. Gray, Secretary-Treasurer, WAEA, Post Office Box 89, Berkeley, California 94701

SOUTHERN AGRICULTURAL ECONOMICS ASSOCIATION

Annual membership dues (includes proceedings issue of *SJAE*)	$3.00

Direct correspondence concerning membership to John C. Redman, Secretary-Treasurer, SAEA, Department of Agricultural Economics, University of Kentucky, Lexington, Kentucky 40506.

CANADIAN AGRICULTURAL ECONOMICS SOCIETY

Annual membership fees	(Can.) $10.00

Mail fees to Treasurer, CAES, Box 632, Postal Station B, Ottawa, Ontario, Canada.

News Notes

CORNELL UNIVERSITY

APPOINTMENT: **Timothy D. Mount**, assistant professor.

LEAVES: **D. J. Allee**, Systems Analysis Group of the Special Assistant for Civil Functions, Office of the Secretary of the Army; **D. G. Sisler**, Yale University Growth Center (one year).

AWARDS: **L. C. Cunningham**, Professor Emeritus, Agricultural Counselor Award, Farm Credit Banks of Springfield, Massachusetts, and Fulbright Lectureship, University of West Indies, Trinidad (one year).

ECONOMIC RESEARCH SERVICE, USDA

(C&MS is Consumer and Marketing Service; ESAD is Economic and Statistical Analysis Division; FDTD is Foreign Development and Trade Division; FPED is Farm Production Economics Division; MED is Marketing Economics Division; OECD is Organization for Economic Cooperation and Development; NRED is Natural Resources Economics Division; TSAB is Trade Statistics and Analysis Branch.)

APPOINTMENTS: **L. Jay Atkinson**, acting chief, Economic Development Branch, FDTD, after return from 2-year assignment in Colombia; **John R. Brooker**, MED, Gainesville, Florida; **Charles Handy**, Ph.D. Cornell, MED, Washington, D.C.; **David N. Harrington**, FPED, Washington, D.C.; **Arthur B. Mackie**, formerly of Economic Development Branch, FDTD, acting chief, TSAB; **D. C. Myrick**, formerly assistant to Director, FDTD, coordinator of newly formed Foreign Programs Group in Office of Director, FDTD; **Robert E. Oehlschleager**, FPED, Pullman, Washington; **Jerald O'Mara**, MED, Raleigh, North Carolina; **Bushra Abdel Sayed**, Ph.D. Michigan State, NRED.

TRANSFERS: **Robert F. Boxley**, NRED, from Michigan State University to Washington, D.C.; **William D. Givan**, FPED, from Blacksburg, Virginia, to Athens, Georgia; **Vernon Grise**, FPED, from Lexington, Kentucky, to Washington, D.C.; **Donald S. Kuryloski**, from ESAD, head of Vegetable Section, Commodity Analysis Branch, to C&MS, head of Vegetable Branch, Fruit and Vegetable Division; **Glenn A. Zepp**, FPED, from Storrs to Washington, D.C.

LEAVES: **Reed Hertford**, FDTD, returned from 3-year research assignment in Mexico; **Sheldon Williams**, MED, Champaign, Illinois, 2-year assignment in India.

RESIGNATIONS: **Nicholas Filippello**, FDTD, to McDonnell Automation Company, St. Louis, Missouri, as economic consultant; **Tom Full**, FDTD, to OECD, Paris; **Glenn H. Glover**, FPED, to Cotton Producers Association, Atlanta, Georgia; **Edgar L. Michalson**, FPED, Pullman, Washington, to

University of Idaho; **Robert L. Tontz**, chief of Trade Statistics and Analysis Branch, to Director of Marketing Economics Division, OECD, Paris.

RETIREMENT: **Erling Hole**, FPED, after 33 years of Federal service.

UNIVERSITY OF FLORIDA

APPOINTMENTS: **Leo Polopolous**, formerly research economist with Florida Citrus Commission, professor; **Kenneth C. Gibbs**, **John Holt**, **Anthony A. Prato**, and **William Kary Mathis**, assistant professors.

LEAVE: James E. Ross, formerly Chief of Party with University of Florida-AID in Costa Rica, Contract Coordinator, University of Florida-AID, Ghana.

UNIVERSITY OF ILLINOIS

APPOINTMENTS: **Roland R. Renne**, formerly Director, Office of Water Resources Research, Department of the Interior, professor and Associate Dean of the College of Agriculture and assigned to Uttar Pradesh Agricultural University, Pant Nagar, India, as Chief of Party; **Bruce L. Brooks** (returned from Jawaharlal Nehru Agricultural University, Jabalpur, India), professor; **Robert W. Herdt** and **Earl D. Kellogg**, assistant professors.

LEAVES: **T. A. Hieronymus**, sabbatical (one year); **R. J. Mutti**, sabbatical (6 months).

OKLAHOMA STATE UNIVERSITY

APPOINTMENT: **Paul D. Hummer**, assistant professor.

AWARDS: **Wayne D. Purcell**, Outstanding Teacher in the College of Agriculture in OSU Alumni-Blue Key 1969 Award competition; **John W. Goodwin**, OSU Alpha Zeta Outstanding Teacher Award, 1968–69.

SOUTH DAKOTA STATE UNIVERSITY

APPOINTMENTS: **Max Myers**, formerly head of the Economics Department and administrator of Foreign Agricultural Services, Director of the Institute of Social Sciences for Rural-Urban Research and Planning; **John E. Thompson** is now head of the department; **Raymond O. Gaarder**, formerly Director of Research with the Livestock Producers Association, Chicago, Livestock Marketing Specialist in the Economics Department.

WASHINGTON STATE UNIVERSITY

APPOINTMENTS: **Donald A. West**, Ph.D. Wisconsin, assistant professor; **Roland C. Bevan**, formerly of University of Idaho, and **Joseph G. Hattersley**, research associates; **Eleanor S. Hungate**, formerly of University of Alaska, research assistant.

LEAVE: **Paul W. Barkley**, visiting professor, University of California, Berkeley.

UNIVERSITY OF WISCONSIN

APPOINTMENTS: **Peter G. Helmberger**, formerly of University of California, Berkeley, professor; **Daniel W. Bromley**, Ph.D. Oregon State, assistant professor.

LEAVE: **Bernard L. Erven**, returned after 3½ years with Wisconsin Project, Federal University of Rio Grande do Sul, Porto Alegre, Brazil.

UNIVERSITY OF WYOMING

APPOINTMENTS: **Thomas L. Dobbs**, Ph.D. Maryland, assistant professor; **R. Burke Teichert**, instructor.

OTHER APPOINTMENTS

E. J. Battison, Ph.D. Pennsylvania State, senior resource analyst, Research Management Corporation, Washington, D.C.

Christoph Beringer, formerly with Development Department, OECD, Paris, "Agrar- und Hydrotechnik GmbH," Consulting Engineers, Essen, Germany.

Lon C. Cesal, formerly of Iowa State University, Ford Foundation, Brazil.

Dean T. Chen, Corporate Planning Services, Deere & Co., visiting associate agricultural economist, University of California, Berkeley.

T. K. Cowden, formerly Dean of Agriculture, Michigan State University, Assistant Secretary of Agriculture.

Stanley G. Detering, lecturer in resource economics, University of Nevada.

Chennat Gopalakrishnan, formerly of Montana State University, associate professor, University of Hawaii.

James R. Kendall, formerly head, Food and Feed Grains Section, Agricultural Estimates Division, SRS, deputy director of the division.

Oscar E. Mazuera, Ph.D. Oklahoma State, Agricultural Program Advisor to Cauca Valley Corporation of Development, Colombia.

Wendell M. McMillan, FAO, Programme Manager, PACCA (Programme on Agricultural Credit and Cooperatives in Afghanistan), Kabul, Afghanistan.

Byron D. Oliver, Ph.D. Cornell, operations research staff, National Cash Register, Dayton, Ohio.

Glen R. Purnell (president, CAES), formerly of University of Alberta, Director-General, Economics Branch, Canada Department of Agriculture, Ottawa.

Terry L. Roe, Ph.D. Purdue, assistant professor, University of Minnesota, and agricultural economist, ERS, USDA.

Sujit K. Roy, Ph.D. Pennsylvania State, assistant professor, Texas Technological College.

William Schott, M.S. Michigan State, Central Computing Inc., Lubbock, Texas.

Philip J. Thair, head of department, University of Saskatchewan.

Clifton R. Wharton, Jr. (AAEA director), vice-president, Agricultural Development Council, elected a director of Equitable Life Assurance Society of the U.S.

OTHER LEAVES

Gian S. Sahota, Vanderbilt University, academic visitor, London School of Economics and Political Science (May-Sept. 1969).

OTHER RETIREMENTS

Geoffrey Shepherd, professor of economics, Iowa State University, May 31, 1969.

OTHER AWARDS

James G. Kendrick, 1969 Distinguished Teaching Award, University of Nebraska.

OBITUARIES

Harold Abel, coordinator of Western Livestock Marketing Research since 1947, died in Denver on February 16, 1969, following a heart attack. He was born May 9, 1910, in Lincoln, Nebraska, and is survived by his wife. Harold received his Bachelor of Science degree from the University of Wyoming in 1934. He was first employed by the U.S. Department of Agriculture in 1930 in Wyoming in the Agricultural Estimates Division. In 1938 he transferred to Cheyenne with the Bureau of Agricultural Economics; then, in September, 1947, to Denver to be Coordinator of Western Livestock Marketing Research. In the following years, he was to contribute as much as any single individual toward making regional research in the West a working concept. The office of the regional coordinator in Denver gave continuity and direction to technical committee activities. Workers in experiment stations throughout the Western states will remember the help that this kindly, patient man gave them in getting started in their research and teaching.

Eric R. Berg, professor of agricultural economics at the University of Alberta, died in Edmonton, Alberta, on March 15, 1969, at the age of 48. A native of Fredericksburg, Texas, Professor Berg received the Bachelor of Arts and Master of Arts degrees from the University of Texas and the Master of Science and the Doctor of Philosophy degrees from the University of Illinois. He served in the United States Navy during the Second World War and the Korean War.

Dr. Berg was employed by the U.S. Department of Agriculture from 1959 to 1962 as assistant branch chief and acting branch chief in the Regional Analysis Division of the Economic Research Service. Following his appointment at the University of Alberta in 1962, Professor Berg contributed substantially to the growth and development of the Department of Agricultural Economics. He was an outstanding teacher and an internationally distinguished authority on world trade and futures trading. His research work included fundamental studies in trade patterns and price behavior. Plans are being made for an Eric R. Berg Memorial Fund at the University of Alberta.

Grady B. Crowe, assistant to the chief, Production Adjustments Branch, FPED, ERS, Washington, D.C., died on April 26, 1969. Death was attributed to a massive coronary thrombosis. Dr. Crowe was born in Athens,, Ga. He received the B.S.A. degree from the University of Georgia in 1938 and the Ph.D. degree from the University of Virginia in 1950. Most of his professional career was spent at the Delta Branch Experiment Station in Stoneville, Mississippi, where he was engaged in research and research administration with FPED and its predecessor agencies. During his 20 years at Stoneville, he gained national recognition as an outstanding authority on the economics of cotton production. In 1953, he received a superior service award from the USDA for meritorious research on economic problems of cotton mechanization. During World War II, he served with the 18th Infantry, First Division in Central Europe. He was a member of Phi Kappa Phi and the American Agricultural Economics Association.

Eric Englund, 76, retired foreign service officer and former Department of Agriculture official, died in February after a long illness.

Born in Sweden, he came to the United States at the age of 14 and became a naturalized citizen in 1917. He was graduated from Oregon State College in 1925. Englund also received an M.S. degree in agricultural economics from the University of Wisconsin and a doctorate in economics from Harvard University in 1936.

Beginning in 1926, he held various positions with the Department of Agriculture, including branch chief of the Office of Foreign Agricultural Relations, from 1942 to 1946. Following his appointment as agricultural attache in the Foreign Service in 1946, he was assigned to Stockholm and Helsinki. In 1950, he was appointed assistant director of foreign agricultural relations for the Department of Agriculture. Mr. Englund then served as agricultural attache to London from 1952 to 1958, shortly before his retirement.

He was made a Knight of the Royal Order of the North Star by King Gustaf of Sweden in 1950 and received the Distinguished Service Award from the Department of Agriculture in 1957. He was a past president of the American Farm Economic Association and a member of the Swedish Academy of Agriculture.

He is survived by his wife, Gladys.

Albert R. Graf, MED, ERS, cereal grain specialist, died on April 20, 1969. He retired from MED in 1968.

Gabriel Lundy, head of the agricultural economics department at South Dakota State University from 1936 to 1949, died on November 2, 1968, following an automobile accident. He pioneered the early development and growth of the economics department.

Henry C. Taylor, 96, acknowledged as the "father of agricultural economics," died at Sibley Memorial Hospital, Washington, D.C., April 28, 1969, following a lengthy illness.

Dr. Taylor's career in agricultural economics spanned more than 60 years and included authorship of the first agricultural economics textbook in 1905. Dr. Taylor also helped to establish the first department of agricultural economics in the United States at the University of Wisconsin. He spearheaded the organization of the Farm Management Association, later known as the American Farm Economics Association, which he served as fellow and president in 1920. He was a life member of the Agricultural History Society and served as its president in 1936.

"Henry Taylor knows, as few men know, to what extent the agriculture of the world is a common concern of every people," wrote W. E. Hocking in his book, *The Lasting Elements of Individualism.*

Dr. Taylor was born at Stockton, Iowa, in 1873 and received his Bachelor of Agriculture degree in 1896 from Iowa State College. His master's degree was earned in 1898, also at Iowa, and his doctorate from the University of Wisconsin in 1902.

Dr. Taylor's capabilities in agricultural economics and rural sociology earned him the chairmanship of the Agricultural Economics Department at Wisconsin in 1909, a position he retained until 1919. He was affectionately dubbed "Agrostis" (*agrostis alba,* the botanical name for redtop) by his students.

Dr. Taylor moved to the U.S. Department of Agriculture in Washington, D.C., in 1919. During the next half dozen years he headed the Office of Farm Management and Farm Economics and the Bureau of Markets and Crop Estimates and was the organizer and first head of the Bureau of Agricultural Economics. In 1925 he left the Department for Northwestern University and its Institute for Research in Land Economics.

During Dr. Taylor's career he served as director of the survey of rural Vermont, 1928-1931; in Rome on the Permanent Committee of the International Institute of Agriculture, 1933-1935, and as the President of the Institute's 13th General Assembly in 1936. He was managing director of the Farm Foundation of Chicago from 1935 to 1945 and then again came to Washington, D.C. as agricultural economist for the Foundation until 1952.

Dr. Taylor's many writings include these books: *Introduction to Agricultural Economics, Outline of Agricultural Economics,* co-author of *World Trade in Agricultural Products,* and *The Story of Agricultural Economics,* written with his late wife, Anne Dewees Taylor. At the time of his death, a book on the Iowa farm which had been in the family for over one hundred years, was in press.

A daughter, Esther E. Taylor, of Washington, survives.

Hadley Van Vliet, professor and head of the Department of Agricultural Economics, University of Saskatchewan, Canada, died suddenly on December 8, 1968. Born in Saskatchewan in 1914, he received B.S.A. and M.Sc. degrees in agricultural economics from the University of Saskatchewan in 1934 and 1936, with many honors. He had completed most of the work for the Ph.D. degree at the University of Wisconsin in 1938, when he joined the department at the University of Saskatchewan. He was head of the department continuously since 1944. Widely known throughout the United States and Canada as a brilliant mind and fluent speaker, he was likewise recognized for his skill, devotion, and energy in teaching, research, extension, and public service. A Memorial Fund has been established to make awards for graduate study and scholarly work in agricultural economics. Brochures will be sent on request and contributions will be gratefully received. The address is Hadley Van Vliet Memorial Fund, Box 500, Sub. P.O. No. 6, Saskatoon, Saskatchewan, Canada.

ADDITIONS TO LIST OF DOCTORAL DEGREES CONFERRED IN 1968

James C. Barron, B.S. The Pennsylvania State University, 1959; M.S. The Pennsylvania State University, 1963; Ph.D. The Pennsylvania State University, *Public Land Programs and Local Governments in a Three County Region in Pennsylvania.*

E. J. Battison, B.Sc. Carleton University, Ottawa, 1962; M.S. The Pennsylvania State University, 1964; Ph.D. The Pennsylvania State University, *The*

Use of an Extended Regional Input-Output Model to Trace the Relationships Between Basic Factor Inputs and Economic Changes.

Richard T. Dailey, B.S. The Pennsylvania State University, 1953; M.S. The Pennsylvania State University, 1958; Ph.D. The Pennsylvania State University, *Optimum Farm Organizations with Estimates of 1970 Pennsylvania Dairy Farm Numbers and Milk Supply.*

Robert E. Evenson, B.A. University of Minnesota, 1961; M.S. University of Minnesota, 1964; Ph.D. University of Chicago, *The Contribution of Agricultural Research and Extension to Agricultural Production.*

Norman Kauffman Garber, B.S. The Pennsylvania State University, 1950; M.S. The Pennsylvania State University, 1961; Ph.D. The Pennsylvania State University, *Impact of Pooling Arrangements on the Procurement Policies and Practices of a Group of Dairy Firms Obtaining Milk in Eastern Pennsylvania.*

Bruce L. Gardner, B.S. University of Illinois, 1964; Ph.D. University of Chicago, *An Analysis of U. S. Farm Family Income Inequality, 1950–1960.*

ADDITIONS TO LIST OF DOCTORAL DEGREES CONFERRED IN 1967

Roger K. Chisholm, B.S. University of Illinois, 1959; M.S. Iowa State University, 1960; Ph.D. University of Chicago, *The Rate of Return to Investment in Farm Land.*

Lucio G. Reca, Dip. University of Buenos Aires, 1953; M.A. University of Chicago, 1962; Ph.D. University of Chicago, *The Price and Production Duality within Argentine Agriculture, 1923–1965.*

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JOURNAL OF REGIONAL SCIENCE

Vol. 9 **August 1969** **No. 2**

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Population Growth and Agricultural Employment in Latin America, with Some U.S. Comparisons*

WILLIAM C. THIESENHUSEN

Policy makers usually assume that the industrial sector will expeditiously absorb the growth of the labor force. But urbanization in Latin America is so far ahead of industrialization that continued advocacy of the type of agricultural modernization that encourages speedy off-farm migration may merely add to urban unrest. The hacienda system seems to be near the root of the problem and it has an institutional parallel in the sharecropper South of the United States. The campesino and the cropper are, in some sense, analogous; and evidence is presented to show that latifundia-type farming systems are not as able as family farms to (1) provide security of employment or adequate income necessary to keep workers in farming until a late enough stage of development, and (2) support an educational system that is capable of developing the skills needed for urban employment or for upgrading the rural labor force. The seriousness of the current movement to the cities in Latin America is accentuated since slums—the outward manifestation of underemployment and idleness—are growing faster than ours ever did. An agrarian reform policy of "contrived dualism" is briefly outlined; it may be the most inexpensive way to provide employment and increase effective demand, thus "buying time" for the industrial sector to catch up.

BENJAMIN HIGGINS once summarized the major problem of underdevelopment in three words: "too many peasants" [14, p. 120]. Many social scientists agree and believe the problem can be solved only by a massive rural-to-urban transfer of labor.

Formulating the issue in this manner suggests a familiar sequence of prescriptions: (1) push investment in industry to attract farm people to city jobs; (2) substitute mechanization for displaced workers in agriculture to improve labor productivity; (3) improve production per land unit. While this statement of basic strategy is oversimplified, its gross outline has been followed—often unconsciously, sometimes with planning—in many currently developed countries.

Without disputing the necessity of industrialization and the inevitablity of internal migration, we shall argue that in at least some parts of Latin America stopgap policies should be designed to create more jobs for campesinos in farming. This employment should provide greater security and higher income earning potential than farm workers now realize as hired

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WILLIAM C. THIESENHUSEN *is associate professor in the Land Tenure Center at the University of Wisconsin.*

hands on large estates. The agrarian reform proposal to be suggested should also give these farm people in situ an opportunity to develop some basic skills needed to raise their productivity in agriculture—or for urban life—while providing some demand stimulus to the nonfarm sectors.

Higgins echoes many contemporary social scientists as he argues against a "more-farm-jobs" development program: ". . . the solution may not be to retard the movement to the cities by making conditions more attractive in the countryside—a policy which is in itself anti-developmental—but rather to accelerate the rate of industrialization and consequently the rate of employment creation outside the agricultural sector" [14, p. 136]. But this point of view leaves several questions unanswered: Who will supply the effective demand to provide impetus for industry, considering that 60 to 80 percent of the Latin American farm population has a yearly cash family income of less than $500 [7, p. 6]?[1] Where will the relatively large amounts of capital come from to create needed jobs in industry and to invest in related social and economic infrastructure? How will industry employ the huge work force that will enter the labor market in the seventies, considering that it has not even been able effectively to absorb smaller increases in the past? What will be the socioeconomic consequences of more unemployment and underemployment in Latin American cities where many thousands are now without productive work?

Employment, Population Growth, and the Latin American City

Slightly over half of the population of Latin America now lives in rural areas and slightly under half of the work force is employed in agriculture [41, Table 1–13, p. 63 and Table IV–16, p. 37]. The rate of over-all population growth between 1950–52 to 1963–65 was 2.8 percent per year [41, Table IV–16, p. 37]. The population growth rate for cities in this period was a phenomenal 4.6 percent, representing a rise from the 3.8 percent rate that prevailed between 1940 and 1950 [41, Add. 3, p. 36]. Between 1925 and 1960 the urban work force tripled, while the economically active farm population increased by 50 percent [42, p. 36].

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[1] Alexander comments on the need for effective demand when import-substituting manufacturing is a primary focus of development policy, as it has been of late in Latin America: "Sooner or later the import-substitution strategy reaches a point of exhaustion. A point is reached at which an economy has installed virtually all those kinds of industries which can produce commodities formerly imported. At this juncture, the nature of the development problem changes. Instead of being the largely physical one of mounting industries for which there is already a market, it becomes one of amplifying existing markets—if the process of development and growth is to continue. . . . [There] are a few Latin American countries—notably Brazil, Chile, Mexico, and Argentina, as well perhaps as Venezuela, Colombia, and Peru—which have completely or nearly exhausted import-substitution possibilities, at least as a major impetus to further development" [1, pp. 305 and 307].

Growth of the urban labor force is caused by the "population explosion" coupled with massive internal migration. Still, off-farm migration has not been sufficient to offset natural increase. To stabilize the agricultural population, the initial annual rate of population growth in the nonfarm sector would have to be about 5.6 percent, approximately one percentage point higher than at present.[2] To reduce farm population in Latin America would require increasing the rate of farm-to-city migration above this figure or reducing the birth rate.

But even at the present rate, internal migration has strained the facilities of the Latin American city. Approximately 5 million families now live in urban shantytowns and slums. This "marginal" population is estimated to be growing at about 15 percent per year—a rate over 10 percentage points higher than the city population as a whole [7, p. 4].[3] And whether the birth rate will slow down in the immediate future in Latin America is an open question. T. Lynn Smith shows that population growth in Latin America between 1950 and 1960 was unprecedented; he believes that there will be some over-all reduction of this rate in the sixties [32]. This contention seems to be borne out by estimates of birth and death rates for a more recent period than the one he examined. Comparing Smith's birth and death rate calculations for 1959–61 with those of the United Nations for 1962–65, one discovers that the crude birth rate in nearly half of the Latin American countries is dropping somewhat faster than the crude death rate.[4] Thus, for the 15 countries Smith analyzed, one finds a drop of between .3 and .6 of a percentage point in natural increase in five countries; a drop of .1 of a percentage point in five countries; a constant rate in three countries; and a rise of between .1 and .2 of a percentage point in two countries.[5]

These data, coupled with Bogue's forecast that "it is probable that by the year 2000 each of the major world regions will have a population growth that is either zero or is easily within the capacity of its expanding economy to support" [5, p. 11], provide some grounds for cautious optimism about the ability of Latin America to cope with its population explosion. But we must remember the speculative quality of these assertions in view of the provisional nature of intercensal data.

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[2] If agricultural population were to remain stable, nonagricultural population would have to increase at a rate equal to the rate of population growth multiplied by the quotient that results when total population is divided by nonagricultural population. This rate would, of course, be variable over time [8].

[3] Both Manaster [21, p. 25], and Mangin [22, p. 21] estimate the number of urban squatters alone at 25 percent of the population of Lima in 1966. In Rio de Janeiro the comparable *favela* percentage is about 16 [26, p. 50]. Similar percentages could be cited for most Latin American cities.

[4] Compare [32, Table III, p. 21] with [43].

[5] Computed from Ibid.

Moreover, it is sobering to consider that a rapid and immediate decline in the birth rate would have little impact on the size of the labor force for 15 years. Myrdal has further suggested, "Especially since any decrease in the birth rate in an underdeveloped country will ordinarily be a slow and gradual process, we can safely predict that, till the end of the present century and perhaps longer, the labor force . . . in the Latin American countries [will increase] by around three percent . . ." [27, pp. 894–95].

Supplying more jobs in Latin America will be a formidable task. The economically active population in Latin America more than doubled between 1925 and 1960, a 35-year period in which the average rate of population growth was much slower than presently. An increase in the labor force on a similar scale in the United States took the 60 years of high average annual economic growth between 1900 and 1960 [42, p. 35].

Thus, whether Latin American economic policy in the foreseeable future succeeds or fails will depend both on increasing average per capita income and on the related (but sometimes quite distinct) matter of creating adequate employment.

Slow Absorption of Workers in Industry

Economists intuitively look to industry and, more particularly, manufacturing as the major job source in the course of economic growth. But it appears that more employment will be needed than Latin America's secondary sector can possibly provide in the short run. Even its manufacturing component has employed labor at a lethargic pace. Myrdal explains the slow absorption of labor early in the contemporary development process by noting that where manufacturing implies rationalization of earlier and more labor-intensive firms, the new factories ". . . will out-compete craft and traditional production and the net effect on labor demand will be negative . . ." [27, p. 895].

This is an overstatement—but not a gross one—of the recent Latin American situation. In 1950, 7.4 percent of the labor force worked in artisan crafts; by 1965 the figure had dropped to 6.3 percent. This slump more than canceled the slight percentage increase in factory employment, so that the manufacturing sector as a whole (factory work plus artisan industries) employed about 14 percent of the work force in 1950 and only 13.7 percent in 1965. Numbers engaged in manufacturing increased at an annual rate of 2.4 percent from 1950 to 1965, but the rate slowed to 2.1 percent at the end of the period (1960–65) [47, pp. 28 and 29; 41, Table 1-13, p. 63].

The participation of manufacturing in nonagricultural employment sharply illustrates the failure of this sector to utilize the labor force moving into urban centers. Between 1925 and 1960, manufacturing was able to absorb only a little over 5 million of the 23 million added to the urban labor force [42, p. 35]. Put differently, an estimated 35.4 percent of a relatively small nonagricultural labor force were engaged in manufacturing in 1925; but by 1960, as urbanization advanced, the percentage had dropped to 27.1 [47, p. 26]. In most developed countries, the ratio of manufacturing jobs to urban employment remained essentially constant over long periods of time—and at a much higher level.[6]

In sum, a 5.6 percent average annual increase in manufacturing output was associated with a 2.1 percent average annual growth in employment between 1960 and 1965.[7] While it is hoped that investment and effective demand can remain high enough to increase both rates, the output-to-labor ratio will probably become more unfavorable to employment in the future. From a technological standpoint, manufacturing in Latin America is likely to become less rather than more labor intensive. It may be possible to foster economically justifiable policies that retard this trend in a few industries from time to time, but it is difficult to see how enough jobs can be created thereby. For example, income redistribution policies should shift the demand structure for manufactures (in the short run) away from its current emphasis on intermediate and even heavy lines to more labor intensive consumer nondurables, for which markets are presently exhausted in most Latin American countries. This development would also ease balance of payments difficulties. Even so, Barraclough explains, "A new factory in Medellín or São Paulo will generally adopt the labor saving technology of industries in present-day Detroit or Pittsburgh, not that of 19th century Birmingham or Manchester" [2, p. 19].[8]

The picture is not much brighter in the industrial sector as a whole

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[6] Experience in industralized nations points to two basic features: (1) a relatively high percentage of urban employment is engaged in manufacturing, and (2) this percentage persists over long periods. "Thus, for example, it has been shown that the percentage in the United Kingdom in 1951 (51.9 percent) was practically the same as in 1901 (51.1 percent); in Italy, after a slight decline during the twenties, the percentage remained little below that for the beginning of the century (59.5 percent in 1901; 56.6 percent in 1939; and 53.5 percent in 1954). . . . In the United States the percentage has been lower, but has also shown very little tendency to decline over the long term (47 percent in 1870; 44 percent in 1900; 45.4 percent in 1920; and 42.3 percent in 1950)" [42, p. 36].

[7] Computed from [41, Tables 1–11 and 1–13, pp. 50 and 63].

[8] Glade [11] argues that in the initial push toward import substitution in the '40's and '50's, manufacturing activity was concentrated in nondurable consumer goods many of which were, relatively speaking, quite labor intensive. By the mid-fifties, however, major dynamism had gone out of these fields, and the focus of industrialization shifted to consumer durables and basic industrial goods that are less labor intensive. Miller [24] shows that employment stabilization policies and, by inference, some other kinds of social legislation have contributed to a decline in employment opportunities and increasing substitution of capital for labor in the secondary sector. See also [42].

(mining, manufacturing, construction, and associated technological services). In 1950–55, it employed 44 percent of the addition to the nonfarm labor force; in 1955–62, only 36 percent [39, p. 40].

Because the nonfarm goods-producing sectors have not absorbed a substantially larger percentage of a growing labor force lately, more workers are drifting to the tertiary sector ("other services") and to what the United Nations has called "unspecified activities"—mainly disguised unemployment. In absolute numbers, 1965 employment in these subsectors was nearly double that for 1950—a growth that does not seem to be in line with the need for services engendered by the region's slow rate of economic growth [47, p. 29; 40, p. 62 and Table 1–13, p. 63].

The Economic Commission for Latin America recently elaborated on the oversimplified assumption that "other services" and "unspecified activities" provide the only refuge for the nonfarm underemployed by observing that all sectors seem to have high-, medium-, and low-productivity subsectors. It estimates, for example, that in manufactures, construction, and technological services, the work force allocated to each productivity subsector would be about 20, 60, and 20 percent, respectively. As urbanization proceeds at a rate faster than industrialization, new in-migrants—if they are absorbed at all—are employed in the low-productivity subsector [47, pp. 30–31]. It stands to reason that if the economies of Latin America do not grow much faster and if rural-to-urban migration continues at the present pace, the capacity of this subsector to provide jobs will become saturated, raising open unemployment to very high levels [44; 47, pp. 32–35].

One can conclude, therefore, that industrialization must be given as much impetus as scarce resources allow, but that unless Latin America is willing to suffer the massive social unrest that idleness and underemployment may well spark, agriculture must be relied upon not to repel workers to the extent it has in the past. This is not because of any inherent advantages of farm employment, but because the capacity of industry to utilize labor in Latin America is not as rapid as necessitated by the high rate of in-migration.

Farm Financed Social Welfare: the U.S. North, the South, and Latin America

Even though there are indications that much privately owned farm land is not used to capacity, given present technology [16], agriculture in most of Latin America does not now provide an adequate haven for underemployed and jobless people. One reason is to be found in the manner in which farming is organized. Large estates (plantations or haciendas) encompass most of the best land—except in Mexico, Bolivia, and Cuba—

and are worked by large numbers of hired laborers who have little or no bargaining power.

When farming is structured in this manner, it: (1) does not provide either the security of employment or adequate income necessary to keep workers in farming until a late enough stage of development and (2) does not permit a viable community organization to flourish that would support an educational system capable of developing basic literacy and the skills and attitudes needed for urban employment or for upgrading the rural labor force.

When management is separated from the more-than-ample supplies of poorly-organized labor, as in the estate system in Latin America, resource owners can offer an extremely low wage and are freer than in a family farm system to discharge workers who have few employment alternatives.

On the other hand, while an owner-operator may sell out when the situation becomes acute, he cannot fire himself or his family labor when he is caught in a cyclical cost-price squeeze. Consequently, in a system dominated by the family farm a large proportion of surplus labor takes the form of involuntary underemployment in the countryside rather than involuntary unemployment in town. Even today U.S. agriculture harbors a surprisingly large amount of surplus labor.

As Owen has argued, farming in the United States has thus performed a self-financed social welfare function: redundant labor resources have not only funded their own sustenance, they have also been expected to cover a substantial percentage of their schooling costs and to support a large portion of other necessary social overhead capital [29, p. 62].

With each passing year, U.S. agriculture performs this function less adequately. By relying too heavily on farm-financed social welfare, our affluent country has consistently overlooked its rural poor [30]. While liberals may abhor this neglect, they must admit that the "agrarian dualism" which developed throughout this century had some important advantages: one subsector of farming has provided immense production, while the other afforded a stopgap matrix of jobs that retarded premature cityward migration. Through primarily locally financed schools, agricultural communities have helped to prepare farm people to be more productive in agriculture if they remained, and in urban employment if they migrated.

U.S. agricultural dualism has not been static; land in the welfare subsector constantly "moves" into the growth subsector in response to the dynamic functioning of the market. Labor-saving capital has now become so cheap relative to labor that for the past several decades farming has been caught in an accelerated combination of farm units accompanied by a release of labor. Labor has not always benefited from these land and capital "flows." That some entire communities have been "left behind" is but one indication that farm-financed social welfare has not worked altogether smoothly; this implies that supplementary policies to cope with rural poverty in the United States are long overdue.

But in some parts of our country—notably much of the South—farm-financed social welfare never was a part of the institutional framework. To the degree that the southern sharecropping system separated ownership-management from labor (that had little countervailing power) and discouraged the education of the farm work force, it can, albeit roughly, be compared to the Latin American hacienda or plantation. Indeed, the southern cropper may be considered as one U.S. analogue of the Latin American hacienda worker.[9]

These farming systems seem to have serious urban repercussions. In the United States, the problems of today's ghetto are not due to racial prejudice alone (in boom periods, Negro unemployment in cities does drop somewhat). They are at least partly due to the release of an unskilled and even illiterate labor force that could not be fully hired by industry at the stage of development it was passing through. Kain and Persky conclude:

> The North's biggest cities attract large numbers of rural Negroes from the Core South. Smaller Northern areas draw disproportionately large numbers of Appalachian whites. Ironically, it is these groups that are relatively the worst prepared for coping with the complexities of the industrial, metropolitan North. The educational achievement of each is inferior to the majority of the Southern population from which they came. Negroes of the Core South are especially disadvantaged in this respect. In analyzing the distribution of poverty in the North Central region of the country, we found that a substantial fraction of the metropolitan North's poor were born and educated in the South. . . . Finally, we have found no evidence to support the widely held view that rural Southern migration to the North will soon abate [17, pp. 73–74].

And if the central city problem here has some roots in a remnant plantation system, which represents only a small fraction of U.S. agriculture, one cannot but be alarmed at the potential for social unrest in most Latin American countries where the preponderance of the land is organized along similar lines and where slum settlements are growing faster than ours ever did.

As the campesino was deprived of land from colonial times, so was his U.S. counterpart—especially if he was black. Even the Homestead Act benefited the black little; his pleas for "40 acres and a mule" after the

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[9] There are other analogues, like the "company town" poor white from Appalachia and the blacks of the central cities who live in absentee-owned slum units and may be victimized by high rents as well as lack of community control.

Civil War largely went unheeded [23].[10] Recent commentators have noted of the immediate *post bellum* period: "The planters still owned the land but they needed a labor supply to farm it. As a result, a new kind of partnership—sharecropping—was formed. The landowners supplied land and work stock and the newly freed Negroes supplied the labor to continue farm production in much the same pattern as before . . ." [20, p. 11].

Movement of blacks out of the South was slow in the late nineteenth century because of adequate employment possibilities in agriculture and a great deal of competition for northern industrial jobs by recent immigrants—mainly of European stock. But during the early 1920's, "The enormous growth of northern industry, the increasing demand for unskilled labor, and the relatively high wages offered by business enterprise, and above all the curtailment of European and Asiatic immigration multiplied the opportunities available . . ." [4, p. 26]. Subsequently, World War II created unprecedented demand for labor and encouraged a much larger out-migration of farm workers. Now, higher welfare payments in the North than in the South seem to provide an additional attraction.

But out-migration also had its "push" aspects—employment possibilities on large cotton farms began to decline in the '20's: "For a few years the boll weevil caused great panic as millions of acres of cotton were severely damaged and production fell . . . thousands of Negroes emigrated as the landlords turned to livestock and dairying" [3, p. 164]. Soil depletion and erosion were the other major problems, especially in the Piedmont country of Georgia and South Carolina, and impelled thousands to leave. The depression, when "the bottom dropped out of the cotton market," seems to have had similar effects [3, p. 164]. In later decades mechanized planting and subsequently mechanized harvesting of cotton discharged more southern workers at a time when the labor market was unable to absorb them in sufficient numbers [6]. And in the sixties, as yet uncounted numbers have been pushed off the farm by reductions in cotton allotments [45, p. 52], and by employers' response to the 1966 extension of the minimum farm wage legislation [30, p. 22].

Had the sharecrop system supported adequate schooling, more blacks doubtless would have gotten urban jobs despite the scourge of discrimination. But at the same time that former sharecroppers were being released from southern farms in ever larger numbers, the ratio of skilled-to-unskilled labor required by industry began to rise in accelerated fashion.[11]

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[10] Any description of the plantation-sharecropping system sounds strikingly like that of a hacienda in, say, Peru or Chile. See, for example, [31] and compare this description to one of a latifundia in [16].

[11] The latter day manifestation of this is particularly serious to the U.S. economy. "In [the] word 'skill' lies the answer to the seeming paradox of 3,000,000 unemployed

Describing the inadequacy of the rural southern educational system to prepare workers for these jobs, one commentator [3, p. 188] has noted:

> In 1960, the average years of schooling completed by the nonwhite farm population 25 years old and over was 5.7 years, compared with 8.9 years for the white farm population and 11.1 years for the total urban population.

This says nothing of the comparable quality of schools educating blacks and whites. Nicholls places blame for this situation squarely on the planters:

> In striking contrast to most of the Middle West, the South has been dominated by power groups who, shunning the public schools in the education of their own children, see little reason to tax themselves in order to finance the education of the less privileged classes . . . [28, pp. 110–11 and 113].

Poor farmers who remain today in the planter-dominated parts of the rural South are often nearly destitute and are permitted to remain—in houses they do not own, on land which is not theirs—only because of the paternalistic spirit of large holders. And a high percentage of those who migrated are today living in the ghetto where unemployment—or subemployment—is high.[12] If jobs in the industrial era of our history have become progressively more scarce for the unskilled, one cannot but be alarmed at what this implies for the dawning technotronic age.

Several Tentative Hypotheses

While retrospective conjecture may result in highly inaccurate representations of history, we may pose several plausible but tentative and overlapping hypotheses from our experience with direct relevance for contemporary Latin America: Had a land tenure system that was labor absorptive over the long run been established in the rural South after the Civil War, recent out-migration would not have been as rapid. When it occurred it would have represented a more genuine response to viable economic opportunities. And if that tenure system had fostered farm-fi-

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and a concurrent shortage in manpower. The unemployed are chiefly those who are, in various ways, unskilled. It is our national shame that a very large part of the unemployed are Negroes in slum ghettos who have neither the education nor the training in a specific skill to get a job . . ." [35, p. 8].

[12] In early 1968, unemployment was as low as it has been in the past decade and a half, 3.5 percent of the labor force. But this rate was twice as high among Negroes and higher still among young Negroes living in the nation's slums. In addition to those who are looking for work and cannot find it—the unemployed—the slums hold those who do not have jobs and are not looking for them and those who are looking for full-time jobs and can find only part-time jobs. When all of these groups are combined, the "subemployment rate" reached 24.2 percent in Boston's Roxbury; 28.6 percent in Harlem; and 34.2 percent in Philadelphia, for example [19].

nanced social welfare, laborers would have reached the urban labor market more adequately prepared for urban life.

Evidence bearing on this speculation is scanty. But when all rented and sharecropped units in the South—as well as those that are partially or fully owned—are counted as farms, in all but four census periods from 1900 to 1964 either (1) numbers of farms operated by blacks disappeared more rapidly than farms operated by whites, or (2) numbers of Negro units declined while numbers of white units increased (Table 1). Differences in the opposite direction in the four exceptional periods were slight. Thus, it appears that through most of this century the institutional framework of Negro agriculture has been less able than the white system to hold labor and that this situation becomes steadily more unfavorable to the black as the century wears on.

Table 1. Percent increase or decrease in number of farms: the U. S. South[a]

Census period	Percent increase or decrease of nonwhite farms[b]	Percent increase or decrease of white farms	Percentage points of difference
1900–10	20.2	17.4	+ 2.8
1910–20	3.7	3.5	+ 0.2
1920–25	− 9.9	0.7	−10.6
1925–30	6.0	1.8	+ 4.2
1930–35	− 7.5	11.3	−18.8
1935–40	−16.6	−10.7	− 6.1
1940–45	− 2.2	− 4.8	+ 2.6
1945–50	−16.0	− 5.5	−10.5
1950–54	−17.1	−11.4	− 5.7
1954–59	−42.7	−25.6	−17.1
1959–64	−32.0	−13.5	−18.5

[a] Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

[b] Farms include the full array of tenure types from full ownership to cropper, including all rented land; the "nonwhite" census designation approximately equals "black" in the South.

Source: *1959 Census of Agriculture,* Vol. II, General Report: Statistics by Subject, Table 5, pp. 1032–33. 1959–64 data calculated from *1964 Census of Agriculture,* Vol. II, General Report, Ch. 8, Table 3, p. 756.

Looking only at farm consolidation one may, on balance, understate the amount of Negro off-farm migration that occurred. Since rural blacks have families that are larger than the families of rural whites, there are proportionally more people who must leave for other work at some time in their life cycle—even when the family head is not fired. Each 1,000 nonwhite farm women 40–44 years old in 1960 had given birth to an average of 5,618 children; each 1,000 rural white women in this age bracket had borne an average of 2,873 children [45, pp. 52–53].

The issue becomes somewhat clearer when race is distinguished from tenure type. Table 2 omits all tenants but croppers, the tenure type most intimately associated with the remnant plantation system. In each census period after 1925–30, farm owners in the South (the majority, of course, family farmers) have been far more able than the croppers—whether white or black—to remain in agriculture. Some croppers became hired farm labor in mid-century, but on the average only one hired hand was engaged for each three or four croppers that were discharged [45, p. 51]. It should be noted that there is more similarity in the trends within the "owner" and the "cropper" categories than within those of "white" and "black." Thus, the plantation sharecrop "system" seems to have contributed importantly to reducing the job opportunities in agriculture; it seems less able than family farming to maintain employment in the face of adverse prices (the '30's) or mechanization (the '40's and '50's).

Table 2. Percent increase or decrease in number of owned and cropper farms: The U. S. South.

Census period	Farm owner		Cropper	
	Percent increase or decrease of nonwhite farms	Percent increase or decrease of white farms	Percent increase or decrease of nonwhite farms	Percent increase or decrease of white farms
1910–20	1.9	6.3		
1920–25	−10.6	− 4.4	3.2	11.0
1925–30	−12.0	−10.5	14.1	24.6
1930–35	6.8	13.3	− 6.2	− 7.7
1935–40	− 5.5	− 0.3	−18.8	−24.4
1940–45	13.4	13.7	− 9.6	−17.5
1945–50	−12.1	− 5.8	−26.7	−22.3
1950–55	− 8.2	− 9.8	−19.1	−22.8
1955–59	−30.9	−25.2	−54.2	−54.8

Source: *1959 Census of Agriculture,* Vol. II, General Report: Statistics by Subjects, Table 5, pp. 1032–33.

Race is a lesser complication in much of Latin America, but the hacienda system seems no more viable than the sharecrop system in providing adequate educational facilities or a stopgap matrix of jobs.

Absorption of Labor in Agriculture in Latin America

Like the remnant southern plantation, the hacienda is not noted for its ability to absorb labor. The set of studies by the Inter-American Committee on Agricultural Development [16; summarized in 41, Add. 4], which focuses on seven Latin American countries with a traditional agrarian structure, shows that production per acre is inversely related to farm size; and while latifundios are 400 times larger than *minifundios* on the average, they employ only 15 times more workers.

As in the U.S. South, a variant of noblesse oblige has been some substitute for self-financed rural welfare on family farms—owners who feel responsibility for their workers' protection have not fired resident labor even after the factor is in surplus [28]. But in Latin America, as in southern United States, this spirit is no longer widespread.

More serious than the issue of resident labor, proportionally fewer seasonally hired workers (who make up the bulk of the rural labor force) are now being contracted. A noticeable shift in some countries is being made from cash crops—which require a substantial amount of labor—to livestock. Then, too, pressures for the adoption of labor-saving farm technology in Latin America are similar, if not yet as pervasive, as those in industry. Minimum agricultural wage legislation is making labor more expensive in relation to capital. In some countries, notably Venezuela, those who mechanize are often able to obtain machinery at relatively low cost with cheap credit and long term repayment arrangements. While sometimes necessary to increase product per unit of land, the effect of mechanization on production—which is primarily labor displacing—is usually not as great as would be equivalent expenditures on yield-increasing inputs such as fertilizers, hybrid seeds, and protective chemicals.

Even if land taxes that cannot be evaded are utilized as a means to modernize agriculture, large landowners may find it profitable—at least as long as inflation continues—to dislodge workers and substitute capital for labor to meet this new fixed cost, instead of selling out.

Education of the Rural Labor Force in Latin America

Landlords who dominate Latin American economies and politics usually send their children to urban schools. Hence, those with investable funds have little interest in improving rural education. In Chile, generally considered to have one of the most progressive school systems in Latin America, only four of ten urban first graders ever advance through the sixth and final elementary grade; of every ten rural students who enter primary school, only one is graduated. The dropout rate is higher in the countryside than in town because of longer distances to school, more illness, greater labor needs at home, poorer facilities, and fewer books. Most dropouts leave before they learn to read and write [46; 47, pp. 43–48].

Primary school graduates are only slightly better off. The curriculum in the grades is largely unrelated to the background of the students or to the occupational role they might play if they migrated to town. Furthermore, teachers are usually poorly prepared. For example, in Brazil there are 90,000 employed teachers who have not finished their primary education [12, p. 15]. In Colombia, 41 percent of the urban primary teachers, but 78 percent of the rural, have no more than a primary education [13]. Needless to say, if the products of this system migrate to town, they are ill-equipped to even take unskilled jobs.

By contrast, in Mexico, where the hacienda system has been abolished, one observer [18, p. 52] recently noted:

> There is an upsurge in the literacy level among the young and there are some signs of improvement among the older generation as well. . . . It is not easy to estimate how far the investment in human resources will go, but the course has been charted and the vision of the future quoted below [by Frank Tannenbaum in 1950 from a conversation with President Calles] may not prove to be an idle dream: "in the past Mexico was divided into *latifundios,* with a big house (*casco*) in the center; in the future we will organize it around the village, with a school in the center."

Citing the experience in Bolivia since haciendas were broken up as part of the revolution of 1952, Hobsbawm states, "The first thing any peasant community does when it can is to build a school" [15, pp. 54–45]. In 1964, Mexico allocated nearly a quarter of her annual budget to education, a figure exceeded only by Costa Rica among the 19 Latin American republics. Bolivia spent 17.9 percent of her budget in education; only the aforementioned and El Salvador, Panama, and Honduras had better records [40, p. 39].

Implications for Agricultural Development Policy in Latin America

Unless other policies intervene, one impact of agricultural "modernization" now occurring in most of Latin America may be that workers will leave the farms for cities at an increasing rate in the next decade. This argument implies that a concerted effort should be made to slow the rate of farm-to-city migration until industry is able to absorb labor at a faster rate. Unfortunately, colonization of new lands in Latin America may be too slow and expensive and some measure of land reform may be the only alternative for the task at hand, in spite of the understandable opposition of the landed.[13]

To partially meet immediate employment needs, "contrived dualism," which has parallels in the historic development of agriculture in our North and West, might be considered by development planners in Latin American countries with a traditional land tenure structure:[14]

(a) *Subsector that emphasizes growth in marketable surplus.* It would seem as though the progressively managed large farm and plantation subsector should be stimulated to greater productivity through the application of more yield increasing inputs, since these are the farms that feed the city and provide export earnings. At the same time, as much employment and income security as possible should be encouraged in this subsector without creating disincentives for management.

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[13] Especially since the writings of Ragnar Nurkse, the possibility of a capitalistic system providing the rural underemployed with productive work through rural public works projects has been recognized. See a late advocacy of this position in [25, pp. 64–66]. The present author does not argue with the desirability of this policy alternative but doubts that it is sufficient for the task at hand.

[14] The following points are detailed in [36] and [37].

(b) *Subsector that emphasizes growth in employment.* The existing subsector of very small farms can probably continue to absorb some population increase until development-created employment begins to catch up with population growth. If technology can be adapted to their needs (as in Japan and Taiwan) and if markets and credit can be made available to them, these small farms might employ even more people and make a greater contribution than presently to marketable surplus.

Programs to provide secure and legal title for present occupants may be inexpensive and are of great importance in some areas. Most Latin American countries have farmers who are "squatters" on public lands; there are several hundred thousand farmers who do not have title to the land they farm [38]. This is not conducive to employment stability, nor does it offer the security required for long-term investments in agriculture.

Since underutilized and poorly managed land on traditional large-scale farms contributes little to production, and since its absentee ownership and paternalistic labor patterns are vulnerable to labor unrest and consequent worker eviction, it should be transformed into new peasant farms. Past performance gives no indication that large investments in the traditional subsector of agriculture would result in either enough increased production or rural employment to meet the needs of the growing population.

As with existing small farms, attempts should be made to move reform-created farms as rapidly as possible toward commercial agriculture with limited mechanization, more use of yield-increasing inputs, and improved extension-type services. Given the exceedingly scarce supply of resources available, however, this may need to be regarded as a long-term goal rather than a present possibility. Even if, for the time being, reform does no more than provide sustenance for large numbers of rural people, it will contribute to economic and political stability and buy time for industrial development to catch up with population growth. As the labor market tightens, land and capital should be freed for the "primarily marketable surplus" subsector. That this will happen only over the long run because of the current high rate of population growth should not surprise us.

A high cost colonization program will be counterproductive; if it costs more to settle farmers on the land than to secure a job in manufacturing (as unfortunately it has in some countries), land reform will soon grind to a halt. If "agrarian reform" actually displaces labor—as it also may have done in some countries—it will not have fulfilled its prime objective [34]. Whatever program is adopted, settlement cost per family must be low.

Furthermore, the need is for flexible agrarian policies and more research on an exceedingly complex situation. Doctrinaire and ideological solutions are inappropriate, not only because conditions vary from country to country, but also because the policy needs of a given country vary over time. Thus, the post-reform tenure system may or may not take the form of the family farm.[15] In general, however, the emphasis should be on increasing production at low cost through yield-increasing technology along with maximum employment and employment security. A cue—but no recipe—can be taken from U.S. history, and emphasis should be placed on creating a milieu in which farm-financed social welfare can become part of the institutional fabric.

If the current population growth rate continues for several decades, no stopgap expedient of agricultural employment will be able to provide enough jobs to accommodate the burgeoning work force.[16] And only a completely unprecedented rate of economic growth will be able to provision it.

Even if the birth rate should fall in the seventies or eighties, if little or no land reform takes place in the meantime, it is likely that by the nineties or even sooner social scientists will be studying ways to reconstruct after a complete institutional breakdown in Latin American cities.

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[15] Even though a type of cooperative farming known as the *asentamiento* is being utilized in the early stages of the current Chilean reform, research on eight such farms the year after incorporation into the program [10] shows that both employment and production practically doubled from the pre-reform situation. Whether this type of organization is too expensive relative to output, whether it will be viable over the long run, whether it is adversely influencing the existing commercial subsector of agriculture, and even whether it can survive the serious 1968 drought are matters for further research and observations. Over time, it is conceivable the asentamiento may have the problems that have plagued the proportional profit farm in Puerto Rico. Relieving unemployment had been one avowed intent of this land tenure arrangement. Now, 16 unions bargain with the Land Authority, the government agency vested with most management functions. They have pursued a militant wage policy, coupled with featherbedding techniques that have increased operating expenses and caused consistent negative profits on some farms [9, 33].

[16] Absorbing labor until industry was ready to provide employment was one avowed goal of the Mexican reform. Even though the Mexican industrial sector is now the most dynamic in Latin America, population growth continues high. Numbers of landless workers are increasing rapidly and there is little more land available to accommodate them. In this context, one cannot fall back on the agricultural sector for additional stopgap employment. Continued high rates of population growth, it seems, will eventually thwart all possibilities of providing the work force with jobs.

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Determinants of Farm Family Income Inequality*

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Income inequality is classified as "long run" when due to the distribution of resource ownership and "short run" when due to transitory disturbances or variations in returns to comparable resources. Owing to deficiencies of census size distributions of income, data pertaining to the distribution of human and non-human resources are used to estimate long-run inequality for each state. A cross-sectional regression analysis of state differences in inequality and changes from 1949 to 1959 yields the following results: (1) labor market adjustments have been influential in reducing short-run but not necessarily long-run inequality; and (2) increases in the capital-labor ratio, the average level of schooling, and research and extension are all associated with increasing dispersion of farm incomes, though also with increasing average incomes of farmers.

THE AIM of this paper is to gain some understanding of the process that determines the inequality of the personal distribution of income among farm people—especially with respect to the consequences of technical progress, off-farm migration, and related developments in U.S. agriculture. Although these events have received considerable attention from economists, little is known about their influence upon the distribution of income within agriculture.

The plan of the paper is, first, to develop an analytical framework for the investigation of income inequality; then, to treat the problem of appropriate procedures for measuring income inequality; and finally, to present estimates of cross-sectional regressions (by states in 1949 and 1959) of measured income inequality on variables intended to represent important developments in U.S. agriculture.

A Framework for the Analysis of Inequality

At least since the time of Ricardo, economists have sought a general explanation of the distribution of personal income. The most useful development in this area has been the work that culminated in the marginal productivity theory of the functional distribution of income. But the link between the functional and personal distributions of income is incomplete in that the marginal productivity theory provides no explanation of the inequality of factor ownership; and although many alternative hypotheses

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have been put forth, there exists no comprehensive theory of income inequality on which to base this investigation.

A problem in this literature is that various and sometimes conflicting views exist on just what kind of process generates the distribution of personal income. Champernowne, for instance, advocates a view that the size distribution of income is generated by a stochastic process [5]. Meade [13] emphasizes the role of savings behavior and patterns of inheritance in determining the long run distribution of income and wealth. Becker [3] developed a theory of the personal distribution of income based on investments in human capital. There are also such specialized hypotheses as Pareto's contention that there tends to exist in any capitalist society a natural, constant degree of inequality [14, p. 648], and Friedman's analysis of the size distribution of income on the basis that individuals with different risk preferences will choose investments which have varying degrees of risk [6].

How can such hypotheses be put to use in analyzing farm income inequality? It is useful at this point to distinguish two types of determinants of inequality and two levels of analysis corresponding to them. The first level, the level of "immediate" determinants of income inequality, derives from the accounting identity of an individual's income as the sum of the payments to factors of production owned by him, so that income inequality can be analyzed as a function of the distribution of factors of production and the rates of return to them. Second, there are the "ultimate" determinants—the factors which influence rates of return and the distribution of factor ownership. A framework for the analysis of the immediate determinants is provided by the marginal productivity theory, as developed in the following section. For the analysis of the ultimate determinants, however, it is necessary to resort to hypotheses like those listed above. But these hypotheses have no direct relationship to the ultimate determinants considered in this paper—the recent developments in U.S. agriculture mentioned above. Accordingly, it will be necessary to develop specific theoretical propositions about the consequences of these events.

The Distribution of Personal Income in Equilibrium

The income of a farm family may be expressed as a function of the labor and capital it owns, the rates of return to them, and a transitory component.

$$Y_i = w_i L_i + r_i K_i + \epsilon_i \tag{1}$$

where Y is current income, w is the wage rate, L is labor supplied, r is the rate of return to owned capital, and K is the value of capital owned. The transitory component includes all unanticipated income (which may be negative). It is assumed to have an expected value of zero and to be uncorrelated with the other terms of (1). Anticipated income is of two basic kinds: income received under conditions of long-run equilibrium and receipts (or losses) attributable to disequilibrium–short-run variations in r or w due to lags in adjustment to changing market conditions.[1]

This classificatory scheme is arbitrary in that one could treat unanticipated work accidents, price changes, etc., as creating divergences between actual and equilibrium rates of return rather than as separate items (ε). The merit of treating unpredictable sources of income variation separately from those that are predictable, but for which long run adjustments are not possible (or do not pay) in the short run, is that the forces influencing the two are not the same. Therefore, the theoretical analysis of income inequality is done more conveniently when these two sources of inequality can be logically (though in this paper not practicably) separated.

The most important distinction to be drawn, however, is that between both types of short-run income variation, on the one hand, and variation that persists in the long run, on the other. Let $w_i = w_e$ and $r_i = r_e$. Then $Y_i - \epsilon_i = Y_E$ is the "equilibrium income" of the ith family. The relative variance of equilibrium income is "long-run income inequality"—inequality that remains when transitory receipts and market disequilibrium are eliminated. The variance of equilibrium income is

$$V(Y_E) = w_e^2 V(L) + r_e^2 V(K) + 2 w_e r_e \, \mathrm{COV}\,(L, K) \tag{2}$$

which, when put in relative terms by dividing by $\bar{Y}^2$ and multiplying by $(\bar{L}/\bar{L})^2$ and $(\bar{K}/\bar{K})^2$, yields

$$C^2(Y_E) = f_L^2 C_L^2 + f_K^2 C_K^2 + 2\rho f_L f_K C_L C_K \tag{3}$$

where V denotes variance, C the coefficient of variation, f the relative shares of L and K in total income, ρ the correlation coefficient between L and K, and bars represent means.

In this context, the possible ways in which the relative variance of equilibrium income can be changed are: (1) shifts in the variance of labor or capital ownership, (2) changes in the relative share of labor or capital, and (3) changes in the covariance between labor and capital ownership. These are the immediate determinants of income inequality. The ultimate determinants will be taken up after dealing with some problems of measuring inequality.

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[1] A problem here is that a change in labor market conditions, for example, may be anticipated by some individuals but not by others because of differences in ability or in investment in information. Such differences among individuals are essentially a matter of non-homogeneity of L and, hence, cannot be handled in terms of equation (1). This difficulty is treated further below.

The Measurement of Income Inequality

The basic data available pertaining to income inequality are the size distributions of rural farm family income of the U.S. Census of Population [20, Vol. 1, Table 65], given by states for 1949 and 1959. The income of these distributions is *annual money* income. The variance of a census income distribution differs from $V(Y_E)$ in that the census data include the variance of transitory income and variations in rates of return due to disequilibria, precisely the items of short-run income inequality that were left out of $V(Y_E)$. On the other hand, some sources of income are included in equilibrium income but not in the census data, namely, non-money income and capital gains.

Given these differences, will the use of census income distributions impair the explanation of state differences in inequality? Yes; first, because of the omission of capital gains. If a new or improved input is developed, for example, at first there will be unanticipated gains or losses, then perhaps some disequilibrium; but after complete adjustment, the consequences for equilibrium income show up in the value of resources whose long run supply curves are not perfectly elastic. The same sequence applies for a shift in product demand. The most important instance of this effect is probably the capitalization of the benefits of government programs into land values—not only for commodity programs but also for such activities as subsidized or tax-exempt irrigation, etc. The census data do not show the wealth effects of any of these factors.

An even more fundamental problem is created by the inclusion of both short- and long-run sources of inequality in the census data. Migration may increase the relative share of capital in income, as discussed below, thereby increasing long-run inequality. But since labor migration is in a sense just the overcoming of immobility, it should be expected to *reduce* the short-run component of income inequality. Of course, this reduction, if it occurs, is important and will be considered separately in the empirical analysis. The point here is that it is impossible simultaneously to identify the positive effect of migration on long-run inequality and its negative effect on short-run inequality when both are included in the same measure.

An Alternative Measure of Income Variance

For the reasons discussed above, the variance of a census size distribution of income is an unsuitable measure of income inequality for the purposes of this paper.[2] Accordingly, I attempted to construct an alternative measure of the relative variance of income by estimating the right hand side of equation (2) for each state.[3] This procedure provides a direct measure of long-run inequality, leaving out any variance attributable to short-run factors. This section treats the main problems encountered in the attempt to measure the various elements of equation (2). The full details of the data and procedures used are not presented, but are available from the author.

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[2] The census data also contain serious random and systematic errors due to misreporting, grouping of large discrete income classes, and the absence of class means. However, the data I intend to use as a substitute for the census size distributions create equally as many problems, maybe more. The main reason for my alternative approach is that it gets *conceptually* closer to the variance of equilibrium income.

Labor income

A first crucial problem is that the specification of (2) is unrealistic in assuming that the equilibrium rate of return to each unit of labor and capital is the same. This problem is most serious for the labor variable; the variance of earnings undoubtedly reflects a good deal more than the variance of time spent working. Accordingly, $V(L)$ was expanded to take into account quality differences attributable to natural ability and acquired human capital.

The elaboration of $V(L)$ is based on the use of an income generating function, as in Welch [22]. The income generating function treats a family's earnings as a function of socio-demographic characteristics presumed to determine income. The coefficients of the function show the effect upon income of having a particular set of characteristics, e.g., being over age 65 with zero schooling. The characteristics that the Census of Population data allowed to be considered were the age, schooling, and race of rural farm family heads and the number of earners per family in 1959.[4] Given the coefficients of the income generating function and the joint distribu-

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[3] The estimated form of (2) was logarithmic, which implies that variances are already in relative terms. The log variance, however, is weighted by factor shares as in (3) rather than rates of return, since the log form of (1) implies that

$$(1') \qquad Y_i = L_i^{\omega_i} \cdot K_i^{\gamma_i} \cdot u_i$$

Given that the marginal contribution of K to Y equals the equilibrium rate of return (r), we get (dropping subscripts):

$$\frac{\partial Y}{\partial K} = \gamma \cdot L^{\omega} K^{\gamma - 1} u = r$$

$$= \frac{\gamma Y}{K} = r, \text{ i.e.,} \qquad \gamma = \frac{rK}{Y}$$

The log form of (2) is thus equivalent to (3) except that log variances replace the coefficients of variation.

[4] For 1949, none of the census cross-classifications of age and schooling with income were available by states. As a result, the 1959 coefficients of the income generating function were used with the 1949 distributions of the characteristics, except for age in the 65 plus group (because of the extension of social security benefits to farmers during the decade). This coefficient was adjusted by using the change in the logarithmic age-income profile between 1949 and 1959. In addition, data were not available on the covariance between labor and capital (the third term of (2)) for 1949.

tion of the characteristics in each state, the variance in income attributable to the variances and covariances of the characteristics can easily be calculated. The result is an estimate not of $V(L)$, but of the whole first term of equation (2); it is an estimate of the variance of equilibrium labor income.

The resulting state estimates of the log variance of labor income had an average value of .28. Since the standard error of the estimated variance (derived from the standard error of the coefficients of the income generating function) is about .04–.05, it is clear that the estimates lack precision. The standard error of the estimated *differences* between states, however, is much smaller because the set of coefficients of the income generating function was the same for each state.[5] Differences between states are introduced only by differences in the distributions of the characteristics.

The income generating function used has the weakness that a family's labor income is taken to be determined by the characteristics of its head plus the number of earners in it. This specification ignores variations in the characteristics of secondary earners. It also leaves out variations in income due to factors not classified in the census; most importantly, differences in natural ability, motivation, and tastes, as well as acquired human capital not captured by years of schooling. As a result, the absolute value of the variance of equilibrium labor income is probably seriously underestimated. However, to the extent that any of the left out factors are correlated with the included characteristics, e.g., schooling, their effect will be picked up by the estimates; and the remaining understatement will not affect the comparisons between states to the extent that the degree of understatement is similar everywhere. The variance of natural ability, for example, may be reasonably constant from state to state.

Income from non-human wealth

The Census of Population contains no data on the ownership of non-human wealth. In fact, for non-farm families, an analysis like the present one could not be done simply because state data on $V(K)$ do not exist. For the agricultural sector, however, the Census of Agriculture contains information on the size distribution of the main agricultural assets within each state.[6]

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[5] Except that regional variation was allowed for the coefficients of race and the characteristic "zero earners"; also, the schooling coefficients, which were based upon Welch [22, p. 89], varied from state to state.

[6] A size distribution of the value of farm land and buildings owned is given for each state in the 1950 Census of Agriculture [19, Vol. 1, Table 18]. But this set of data is not available in the 1959 census—the value of land and buildings is classified by size of farm (acres of land) but not by value. The procedure used to estimate the variance of land and buildings in 1959 was simply to add the change from 1950 to

One difficulty with the use of these data is that the definition of a rural farm family is not exactly the same as that of a farm in the Census of Agriculture. In addition, the capital data are incomplete; there is nothing on the distribution of non-agricultural assets owned by farmers. Also lacking is information about debt, which is needed to convert the size distribution of capital ownership for each state into a size distribution of net worth. At the national level, however, there was sufficient information to adjust for debt [19, Vol. 5, Pt. 4, Table 14]. This adjustment made only a small difference in the estimated inequality of capital ownership, reducing the estimated log variance of capital ownership from 1.88 to 1.86.[7]

Before these capital data can be aggregated with the labor income data, it is necessary to transform the variance of capital into the variance of income from capital. In the logarithmic form of equation (2), this transformation is made by multiplying the log variance of capital ownership by the square of the relative share of capital in total income. The method used to get estimates of the share of capital is summarized by the formula,

$$f_k = \left(\frac{rK}{rK + wL} \right) \alpha + C(1 - \alpha), \tag{4}$$

where α is the fraction of income of rural farm families from self-employment, C is the fraction of off-farm income that was not earnings, r is the rate of interest,[8] K is farm capital, w is the average farm wage rate, and L is average days worked per farm.

1959 in the variance of value classified by farm size to the variance of the 1950 value distribution. A similar method was used for machinery and the covariances between machinery and land. This procedure does not require that the variance of the proxy be the same as the variance of the true variable, but only that the relationship between them be the same in the two years.

[7] Because of the incompleteness of the capital data, it is encouraging that an independent estimate of $V(K)$ at the national level is quite close to the present estimates. Data of a Federal Reserve survey [15] yield an estimate of 1.77 as the log variance of net worth of "farm operators," with a mean value of $44,000 in 1962, of which $26,000 was farm business capital. My capital data give 1.86 as the log variance, and a mean value of $37,600 for net worth with $26,300 of agricultural assets in 1959. For the estimated share of capital in 1950, I obtained .312 and for 1959, .346. D. G. Johnson estimated a share of capital of .324 for 1950 [10, p. 165].

[8] The relevant rate of interest for estimating the variance of equilibrium income (r_e in equation (2)) will not be the average rate of return to agricultural capital so long as there is disequilibrium in the farm sector as a whole. An interest rate which seems more likely to reflect equilibrium conditions is that on the supply side. Accordingly, I used the rate on farm mortgage debt as a basis for r. Similarly, although in some ways using the wage rate paid to hired workers is an inferior measure of w_e, it does have an advantage under conditions of disequilibrium if the short-run elasticity of supply of hired farm labor is greater than that of self-employed labor.

The variance of equilibrium income

Estimates for each state of the elements of the logarithmic version of (2) are now complete. Aggregating these elements according to (2) yields the estimates of the standard deviation of the log of equilibrium income (VY_E) shown in Table 1. For purposes of comparison, the standard deviations of the logs of the Census of Population size distributions of income for rural farm families and unrelated individuals (VY) are also shown.

There is one striking difference between the measure of census income inequality and estimated long-run inequality; the inequality of the distribution of census income declined in practically every state from 1949 to 1959, but the inequality of equilibrium income shows no such decline and, in fact, generally increased. Are these differences merely a matter of the construction of the estimates? What can be said definitely is that the changes in the distributions of age, schooling, earners, race, and ownership of agricultural assets, and the changes in factor shares have been such as to cause the estimated increases in VY_E. It is possible that these factors have been offset by variables whose changes between 1949 and 1959 could not be measured—the coefficients of the income generating function, the covariance between labor and capital, or the non-agricultural capital left out.[9] But, unless these factors changed drastically, the reduction indicated by the census size distributions and by the data of Boyne [4] must be attributable predominately to short-run sources of income inequality or to the omission of capital gains.

Problems of measurement aside, the estimates of VY_E have several important advantages over the use of census income data. First, they yield indexes of income inequality free of the transitory component of income. For purposes of analyzing either the distribution of factor rewards or the inequality of economic welfare it is more meaningful not to include this component. Secondly, the variance of capital gains is explicitly included by using the distribution of capital ownership. Finally, non-money income is included since the valuation of assets takes into account all the returns expected from the ownership of them.

The mean value of estimated equilibrium income is $6400, compared with $4200 from the census data. The exclusion of capital gains and nonmoney income and the inclusion of (negative) disequilibrium returns in the census data each probably accounts for some of the measured difference. Since inequality is measured by log variances, the fact that the

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[9] An additional problem in comparing 1949 and 1959 for both VY and VY_E is that the definition of a farm was changed in 1959. The data presented in Boyne [4, p. 1219], however, show little, if any, effect of the redefinition on measured income inequality.

Table 1. The standard deviations of the logs of total income (VY) and the standard deviations of the logs of equilibrium income (VY_E)[a]

State	1949		1959	
	VY	VY_E	VY	VY_E
Maine	0.970	0.667	0.844	0.667
New Hampshire	0.937	0.586	0.868	0.603
Vermont	0.920	0.618	0.895	0.636
Massachusetts	0.947	0.668	0.920	0.684
Connecticut	0.955	0.706	0.897	0.719
New York	0.935	0.632	0.867	0.641
New Jersey	1.001	0.713	1.028	0.762
Pennsylvania	0.943	0.633	0.846	0.645
Ohio	0.809	0.661	0.811	0.709
Indiana	0.817	0.693	0.821	0.756
Illinois	0.847	0.746	0.836	0.815
Michigan	0.826	0.673	0.791	0.700
Wisconsin	0.814	0.588	0.803	0.614
Minnesota	0.811	0.652	0.830	0.710
Iowa	0.801	0.717	0.835	0.797
Missouri	0.910	0.709	0.883	0.789
North Dakota	0.914	0.667	0.787	0.735
South Dakota	0.877	0.660	0.881	0.751
Nebraska	0.837	0.696	0.776	0.794
Kansas	0.935	0.756	0.818	0.815
Delaware	1.018	0.727	0.998	0.805
Maryland	1.009	0.767	0.986	0.834
West Virginia	0.910	0.579	0.898	0.622
Virginia	0.990	0.714	0.982	0.776
North Carolina	0.919	0.767	0.947	0.833
South Carolina	1.015	0.832	0.992	0.888
Georgia	1.035	0.747	0.940	0.811
Florida	1.003	0.829	1.033	0.908
Kentucky	0.921	0.624	0.923	0.695
Tennessee	0.927	0.606	0.933	0.656
Alabama	1.010	0.780	0.965	0.845
Mississippi	1.029	0.852	0.998	0.910
Arkansas	0.864	0.680	0.938	0.753
Louisiana	0.947	0.781	1.029	0.858
Oklahoma	0.966	0.696	0.851	0.767
Texas	1.038	0.774	0.696	0.830
Montana	1.007	0.644	0.879	0.705
Indiana	0.835	0.610	0.738	0.662
Wyoming	0.928	0.664	0.893	0.747
Colorado	0.946	0.659	0.804	0.708
New Mexico	1.112	0.821	0.978	0.872
Utah	0.741	0.562	0.706	0.598
Nevada	1.012	0.756	1.010	0.801
Arizona	1.085	0.827	1.080	0.879
Washington	0.894	0.673	0.807	0.712
Oregon	0.920	0.622	0.823	0.679
California	0.954	0.743	0.933	0.810
United States	0.952	0.783	0.916	0.815

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[a] The standard deviation of the logs of census income is predicted from the concentration ratio by the method described in Aitchison and Brown [2, p. 112]. These size distributions are for rural farm families and unrelated individuals from [20, 1960, Table 65, and 1950, Table 32].

mean of the distribution is larger does not imply greater variance. Doubling the whole distribution leaves the log variance unchanged.

Long- and short-run inequality

Unless there is strong negative covariance between short- and long-run components of income, the presence of short-run inequality will make the variance of census income greater than the variance of equilibrium income. The more important the short-run components of income, the greater this difference will be. It would be a mistake, however, to consider the difference between VY and VY_E as a measure of short-run inequality in any absolute sense. The variance of census income is substantially underestimated just because of the grouping of income classes.[10] Given the measurement problems discussed above, it would likewise be unwise to regard VY_E as an absolute magnitude. Rather, both are only *relative* indexes, with which one can compare indexes constructed in the same way for other states and years.

Explaining State Differences in Inequality

None of the various hypotheses about the ultimate determinants of income inequality mentioned at the beginning of this paper deals explicitly with the kind of events that have been important in the recent history of U.S. agriculture. Of main interest are the migration of labor from farming, increases in the quantity and quality of capital per farm, increased investment in skills, and government farm programs. This section is concerned with the reasons afforded by economic theory for expecting a connection between these events and income inequality and with the use of the data developed above to investigate these theoretical implications empirically.

The long run

Definite predictions can be made about relative factor shares. Given that income from capital is more unequally distributed than labor income, anything that increases the relative share of capital should increase income inequality.[11]

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[10] Welch found that when he expanded the size distribution of farm operator income from classes of \$1000 to classes of \$10, the log variance went from .92 to 1.82 [22, p. 13].

[11] That capital income variance is greater than labor income variance is not, however, a sufficient condition for an increase in capital share to lead to increased income inequality. From equation (3) we have

$$C^2(Y) = f_k^2C^2(K) + (1 - f_k)^2C^2(L) + 2f_k(1 - f_k)\rho C_LC_K.$$

The effect of a change in capital's share, f_k, is

$$\frac{\partial C^2(Y)}{\partial f_k} = 2f_kC^2(K) - 2(1 - f_k)C^2(L) + 2(1 - 2f_k)\rho C_LC_K.$$

Increases in the quantity of capital per farm and decreases in the farm labor force both can be expected to increase the share of capital so long as the elasticity of substitution between labor and capital is greater than unity. On the other hand, Schultz [17] has hypothesized that investment in human capital may have increased the share of labor. With respect to technical change, the question whether it will be biased or neutral with respect to factor shares cannot be answered a priori.

The preceding comments make use of the distinction between labor and capital. Further propositions can be inferred by treating land separately from other forms of non-human wealth. The view of Marx, for example, that increases in average wealth are "identical with the increase of poverty" [12, p. 97] seems to be based partially on the expectation of an ever larger share of income going to the relatively fixed and unequally distributed factor, land. Such a process ought to be especially noticeable in the agricultural sector. A similar inference can be made with respect to the consequences of government programs. To the extent that they increase the income share of land, owing to its relatively low elasticity of supply, they will increase income inequality.

These events will also alter income inequality if they change the variance or covariance of factor ownership. The consequences of increased schooling or government payments depend upon the position in the income distribution of the recipients. Likewise, to the extent that off-farm migrants are selected from the lower part of the income distribution, migration will reduce income inequality among those who remain. But it is not at all clear that migrants have been, or can be expected to be, drawn from the poorer farmers. In general, the a priori expectations about any of these selectivity effects are weak.

Short-run effects

With respect to technical progress, consider the impact of a new development that concerns only a subset of farmers, e.g., a more efficient machine for harvesting some crop. Such an invention will change income inequality according to the position in the income distribution of those who can benefit from it. In addition, there is the fact that when any improvement occurs, those who are first to adopt it successfully gain, and those who are slow to adjust lose.

Migration and the taking of off-farm work by farm residents and their families can also be expected to have short-run consequences. In general,

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This expression may be either positive or negative. As typical values for these variables for the United States, we get $1.1-.8+.2=.5$ for the value of the partial; this implies that an increase in f_k of the order of magnitude that we had from 1950 to 1960, about .03, would increase the log variance of income by about .015, or approximately a one percent increase in income inequality.

the main short-run impact of such labor market adjustments should be to reduce inequality due to disequilibrium, since such inequality is due to immobility and these adjustments are precisely the overcoming of immobility.

Regression Analysis

The preceding paragraphs have suggested reasons why some recent events in U.S. agriculture should have influenced income inequality. The object of the present section is to discover to what extent differences in income inequality between states and over time are, in fact, explainable in terms of these factors. Following the discussion above, long-run and short-run aspects of inequality are treated separately.[12] The method used is state cross-sectional regressions that have as dependent variables estimated income inequality for 1949 and 1959, as given in Table 1. The independent variables are intended to represent important aspects of recent changes in U.S. agriculture.

Following is the rationale for this approach: The goal of the analysis is to assess the influence of certain causal factors on income inequality, using observations of state size distributions of income. What makes this not a simple task is that many factors are varying at once, so that one cannot look at state differences and tell what particular factors are causing the differences. In this context, regression can be considered simply as an attempt to hold all other relevant variables constant. Now, for some causal factors, this may not be the best way to analyze the problem. To investigate the consequences of the introduction of a new machine, for example, it would be better to look at adopting farmers vis-a-vis others for the whole United States, rather than to put variables about the machine into state cross-sectional regressions. However, for variables of a general nature (e.g., migration), whose effects are not concentrated on any particular subset of the population but which have general consequences arising from factor share changes, etc., the regression approach provides a good method of getting at their net consequences.

Elements of mutual determination

Short-run and long-run inequality have been discussed as independent, separable variables. This independence, however, does not hold if short-run differences in rates of return persist over time. Under such conditions, short-run inequality will affect long-run inequality, owing to the accumulation of wealth from the part of these returns that is saved.

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[12] The short-run component is measured as the residual between the estimated variance of equilibrium income and the variance of total income. This residual is a conglomeration of transitory income, the short-run variance in income due to disequilibrium, and the covariances of these components with equilibrium income, as well as the variance of capital gains and income in kind. The resulting random and systematic error is reflected in the generally lower R^2 and higher standard errors for the short-run regressions.

There are also identification problems due to the mutual determination of income inequality and some of the variables influencing it. Notably, migration has been treated as an equilibrating mechanism, but it is also an indicator of disequilibrium. Similarly, off-farm work by farm family members should reduce short-run inequality, but it is by the same token likely to be taken in response to short-run fluctuations in income. The first effect yields a negative correlation between off-farm work and inequality, and the second a positive one.

In the regressions that follow, I dealt with this problem by the use of lagged variables, using for migration, net migration for the five years *preceding* the year for which income inequality is observed. I also computed regressions for changes from 1949 to 1959 in income inequality. This procedure leaves aside the cumulative effects of past interaction on the levels of inequality that we observe at any given time and enables us to relate changes in inequality directly to contemporaneous changes in the independent variables. The regressions are presented in Table 2.

Interpretation of the regression results

Consider first the variables relating to labor market adjustment. "Migration" here measures the mobility of labor out of the farming occupation, rather than residential movement. Since the capital/labor variable (X_5) should pick up the factor share effects of migration, the sign of the migration variable itself (X_1) probably reflects primarily the selectivity of migration. The high standard error and varying sign of this variable do not indicate that the selection of migrants has been anything other than random. Occupational mobility does, however, appear to have been influential in reducing short-run inequality, as was expected.

It was expected that off-farm work would be associated with decreases in short-run inequality, but the significance of this variable (X_2) in reducing long-run income inequality was somewhat surprising. It may be that the kind of process observed by Tang in the Piedmont is at work [18, pp. 160–62]—that under conditions of capital rationing, off-farm work enables poor farmers to add to their own capital stock, thus decreasing the inequality of wealth and of equilibrium income.

In relation to off-farm work, the degree of income inequality in the non-farm sector becomes important, in particular as related to the relative wages of different skill groups. If high quality labor is scarce in the non-farm economy and its relative price rises in consequence, highly skilled labor in agriculture will be relatively more attracted to non-farm employment. Such adjustments will increase the income of farm people with the most human capital, thereby increasing income inequality within the farm

Table 2. Regression results: Long-run income inequality is the dependent variable, Y_1, short-run inequality is Y_2, and total inequality is Y_3

Independent variable	Dependent variable						
	Y_1	Y_1	Y_1	Y_1	Y_2	Y_2	Y_3
	1949	1959	Pool	Change	1959	Change	Change
X_1 "Migration"	.051 (.044)[a]	.008 (.051)	.033 (.034)	−.012 (.011)	−.128 (.063)	−.026 (.019)	−.042 (.031)
X_2 Off-farm work	−.068 (.026)	−.056 (.035)	−.095 (.025)	−.046 (.011)	−.053 (.043)	−.052 (.056)	−.006 (.031)
X_3 Wage-skill variance in non-farm work	.060 (.026)	.089 (.038)	.094 (.028)		−.036 (.048)		
X_4 Variance (earners per family)	1.87 (.448)	1.19 (.294)	1.95 (.257)	.506 (.155)	−1.91 (.380)	.691 (.275)	1.301 (.422)
X_5 Capital/labor	.007 (.005)	.005 (.004)	.003 (.004)	.001 (.001)			−.019 (.008)
X_6 Schooling mean	.070 (.041)	.117 (.065)	.111 (.042)	.001 (.111)	−.087 (.077)	.283 (.207)	.466 (.304)
X_7 Schooling variance	1.30 (.406)	.831 (.278)	1.32 (.225)	.634 (.361)	.040 (.338)	1.14 (.519)	1.587 (.986)
X_8 Research and extension	.086 (.023)	.098 (.025)	.139 (.020)	.059 (.020)	−.057 (.029)	−.056 (.036)	.065 (.057)
X_9 Government payments	−.003 (.014)	.003 (.015)	.011 (.012)	.003 (.004)	−.001 (.021)	−.017 (.018)	−.029 (.018)
X_{10} Age variance	.181 (1.16)	−.944 (2.28)	.441 (1.16)	.968 (.441)	2.93 (2.78)	−1.89 (.816)	−2.72 (1.20)
X_{11} Mean income	−.042 (.036)	−.122 (.082)	−.105 (.088)	.008 (.016)	−.053 (.106)	−.116 (.030)	−.179 (.045)
X_{12} Race	3.26 (.517)	2.70 (.579)	4.10 (.482)		−3.22 (.725)		
X_0 Constant	−.538	−.354	−1.12	.082	2.66	−.071	.052
R^2	.872	.869	.871	.734	.663	.553	.654
Standard Error	.031	.037	.047	.013	.061	.025	.037

[a] Figures in parentheses are standard errors.

Sources: Y_1, long-run income inequality, and Y_3, census income inequality, are taken from Table 1. Y_2 is the square root of the difference between the log variance of census income and the log variance of equilibrium income.

"Migration" (X_1) is the total disappearance of farm labor during 1945–49 for the 1950 regressions and during 1954–59 for the 1960 regressions. Total disappearance was measured as the ratio of the number of farms times days of labor per farm for the earlier year divided by the same product for the later year. The data on days worked per farm is from Gisser [8, Table 30]. Data on off-farm work of farm operators was available on the punched cards used in Griliches [9]. Variables X_5 and X_8 also came from this source.

The ratio of high-skill wage rates to low-skill wage rates (X_3) was measured as the ratio of the median annual earnings of "craftsmen" over the median annual earnings of "laborers, except farm and mine," from [20, Vol. 1, Pt. 1, Table 140 (1960)].

X_4, X_6, X_7, X_{10}, and X_{12} were based on the distributions given in [20, Vol. 1, Pts. 2–52, Tables 32, 138, 139, 142 (1960); Vol II, Pts. 2–49, Table 20; Vol. IV, Pt. 2A, Table 30, 31, 34 (1950)].

X_9 is the log of government payments per farm as reported in [21, Table 4].

sector. This process is reflected in the strength of the variable representing the variance of wages by skill class (X_3) in the regressions on long-run inequality. Although this effect is caught by the schooling coefficients, and hence is measured as long-run inequality, strictly speaking, it is short-run inequality because it should in the long run be erased by investments in skills until the rate of return on them falls to the normal rate. Whether this adjustment can occur, however, depends crucially on the ability of poor people to invest in skills. And, in fact, increases in the average level of schooling (X_6) are significantly associated with *increasing* long-run inequality.

The variance of earners per family and the age composition reflect differences in family structure of the kind analyzed by T. P. Schultz [16, p. 40]. These variables are used in the regressions to hold inequality constant with respect to state differences in the organization of families, the better to observe the economic impact of the other variables. From these regressions, it appears that the family structure, especially with respect to secondary earners, is quite important in determining observed differences between states and over time.

Next, we have a set of variables relating to the conditions of production in agriculture. The ratio of capital to labor (X_5) has the expected positive sign but is never significant. This result is consistent with other evidence that the elasticity of substitution between labor and other inputs is probably close to unity [9].

On the other hand, the research and extension coefficient (X_8) is significantly positive in all of the long-run regressions. Such activities appear either to have increased the share of capital or to have been so biased that higher income farmers were more readily able to take advantage of them.

The government payments variable (X_9) generally has the expected positive sign in the regressions on long-run inequality. The standard error is so large, however, that the null hypothesis that such programs have had no effect cannot be rejected at any level of significance. This may reflect the fact that, especially in 1949, government payments were a quite small part of farm income.

Finally, the mean level of income was included in order to identify any "residual" association between income level and income inequality. Aigner and Heins [1], following Kuznets [11], treated economic growth itself as a source of declining inequality. While average income was highly significant in the regression on total income inequality (Y_3), it was not significant and its sign varied in the regressions on long-run inequality. This result is consistent with Kuznets' own speculation that the observed association of growth with declining inequality may have been largely attributable to transitory income. It also adds to the suspicion that the decline in farm income inequality observed by Boyne [4] is attributable to short-run factors.

Concluding Remarks

For the regression analysis in general, the variables usually have the expected signs, and the explanatory power of the equations is quite good, especially considering the many deficiencies of specification and data availability. The main measurement problem was that of obtaining a meaningful index of income inequality with which to compare states. The results on the whole, if they do not demonstrate beyond doubt, at least are consistent with the general picture of the generation of income inequality that has been developed in this paper—particularly the proposition that disequilibrium and labor market adjustments have been important in the determination of the inequality of the distribution of personal income. The results also support the general view that state differences in U.S. farm income inequality are explainable on the basis of economic variables and have been not randomly determined, not constant, and not primarily a political matter.

From the point of view of public policy concerning income inequality, the most significant aspect of this investigation may be the result that the factors normally associated with "progress"—technical change, increases in schooling, and increased capital per farm—appear to have increased rather than decreased the variance of equilibrium income. This fact, together with the observation that the recent decline in total farm income inequality (as measured from census size distributions) apparently reflects mainly short-run components of income, does not encourage a sanguine view of the future prospects for automatically declining inequality. Before more definite and specific conclusions can be drawn in this area, however, research of a more detailed nature is required.

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Econometric Analysis of the Agricultural Labor Market*

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Previous research on the market for agricultural labor is extended through the use of a simultaneous-equations model consisting of six equations. The model treats the markets for unpaid family and operator labor, both of which have been slighted in previous work, and takes account of the interdependence among the three components of the agricultural labor force. The demand and supply elasticities were found to differ substantially among the components. Economic implications suggested by the statistical results are analyzed, and the structural models are used to evaluate a number of alternative policies that bear on labor use and labor returns.

THE objective of the research reported in this article was to increase our knowledge about the market for agricultural labor.[1] The research extends previous work and makes a modification in the analytical model that, to the best of our knowledge, has not been considered in previous studies of the agricultural labor market.[2]

The extension of previous work consists of an analysis of the markets for operator labor and unpaid family labor. Previous econometric studies of the agricultural labor market have tended to concentrate on the hired component, although Johnson and Heady [12] have done some analysis of the other components—particularly on the demand side.

The modification in the analytical model consists of attempting to take account of the interdependence among the various components of the labor force. Previous studies have assumed that the market for hired labor, for example, could be analyzed independently of what takes place in the markets for operator and unpaid family labor. In this study, we hypothesize a six-equation simultaneous-equations model that takes account of the interrelationship among the three components. The model consists of demand and supply equations for each component, with price and quantity of all sectors assumed to be endogenously determined, subject to a set of exogenous variables.

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[1] The changes taking place in the agricultural labor market are described in [18].

[2] A brief review of previous studies can be found in Tyrchniewicz and Schuh [23]. Studies published since that article include Gisser [7, 8], Wallace and Hoover [24], Diehl [3], Gallaway [5,6], Perkins and Hathaway [15], and the technical papers prepared for the National Advisory Commission on Rural Poverty [16].

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The Conceptual Model

The basic economic model used in this study hypothesizes that the quantity of labor supplied to agriculture depends upon wages, alternative income opportunities, and the size of the civilian labor force. On the demand side, it is hypothesized that farm operators (1) accept as given the prices they must pay for inputs other than labor and the prices they receive for their products, and (2) adjust their use of labor in the light of these prices, the price of labor, and the technological alternatives open to them in production.

As a first approximation, then, the supply equations express farm employment as a function of real wages of farm labor, a measure of the income earned in nonagricultural employment, the amount of unemployment in the economy (which affects the availability of alternative income opportunities), and the size of the civilian labor force. The demand equation expresses farm employment as a function of real wage rates of farm labor, an index of the prices of agricultural products, an index of the prices of other inputs, and a measure of technology.

Certain conceptual issues arise when this general kind of model is applied to such widely differing components of the farm labor force as hired labor, unpaid family labor, and operator labor. Among these issues are the following:

1. *The degree of interaction or interdependence among the three components of the farm labor force.* Previous studies of the hired farm labor force [19, 20, 23, 12] have assumed that the market for each component could be studied independently of the others. However, substitution and change of category may take place on both the demand and supply sides of the markets, thereby leading to substantial interdependence. For example, the supply of unpaid family labor may affect the demand for hired labor, or the demand for hired labor may affect the supply of unpaid family labor.

In order to test for this interdependence, "substitution" variables were introduced into the demand and supply equations for each component. These substitution variables are the levels of employment of the other components of the labor force and are treated as endogenous or jointly determined.[3]

2. *The appropriate "price" for agricultural labor.* A number of factors are involved. First, the models were developed to explain annual employ-

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[3] Ideally, one would like to introduce the "price" of the other components in analyzing these substitution relationships. However, lack of information on the price of the several components (see below), particularly unpaid family labor, led to our use of the quantity variables. We recognize the theoretical limitations of this approach, but feel that the empirical insights gained outweigh the disadvantage of not having a theoretically pure substitution effect.

ment in year equivalents of labor (an average of the monthly employment). This suggests that some concept of annual labor income in agriculture may be appropriate. However, given the short period of employment for much of the hired and unpaid family labor, an index of wage rates may be more appropriate. Further support is given to this choice, at least for hired labor, when it is recognized that the USDA series on expenditure on hired labor, from which an annual concept could be developed, uses the index of wage rates for intercensal interpolation.

A second factor has to do with the price for unpaid family labor and operator labor. By definition, no fixed wage or salary is paid to unpaid family labor, which receives its compensation as it participates in the returns to the farm family. A similar issue arises in the comparison between unpaid family labor and operator labor. No evidence is available on the extent to which unpaid family labor shares in the total labor return to the farm.

If the labor market functioned perfectly and the quality of labor were the same among all three components of the labor force, the agricultural wage rate could serve as a proxy for the price of labor in each component. To bring some statistical evidence to bear on this question, a measure of net farm income attributable to the family labor force was calculated by charging opportunity costs to the other inputs and calculating the return to labor as a residual. Two estimates of the price of family labor were obtained by alternatively dividing this by the year equivalents of family labor (unpaid family plus operator) and by the number of farms (our estimate of the number of farm operators). Experiments were made with these and the agricultural wage rate in estimating the models for unpaid family labor and operator labor.

Computing the return to family labor as a residual in this way assumes that most of the risk and uncertainty of the income stream in agriculture is borne by the farm operator as a labor owner, or by his family. In contrast, the use of the wage rate would impute most of this risk to the fixed capital assets. The truth probably lies someplace between, but it is not possible to arrive at it empirically.

3. *The market for operator labor.* Once again, a number of problems are involved. First, the farm operator generally owns a number of assets, only one of which is the labor he can supply. Consequently, it might be argued that the number of farm operators (and the quantity of operator labor supplied) is determined not only by the return to labor, but also by the return to the other factors owned, such as land and capital. In this study it was assumed that the market for the several inputs was sufficiently perfect that the level of employment of farm operators could be explained by labor returns.

A second problem has to do with the way in which the demand for operator labor is formulated. Some have argued [for example, 11] that the farm operator might demand more of his own labor services as the return to it increases. This, in effect, would result in a positively sloping demand curve.

In this analysis, we have assumed that the individual farm operator plays two roles and is involved in essentially two decision making processes. As an entrepreneur, he can choose and combine inputs in an optimum economic manner; consequently, he will demand less of an input as its price rises relative to the price of other inputs. As the owner of an asset, on the other hand, he is interested in employing it where it will receive the highest return. Consequently, as the returns to labor in one industry rise relative to those in another, he transfers his employment to another, thereby increasing the supply of labor in the latter. This is a supply phenomenon, however; not a demand phenomenon.

Based on these considerations, a negative relationship is hypothesized between the price of operator labor and the quantity demanded, as for the other two components of the farm labor force. In this formulation an attempt is made to identify the demand and supply forces at work in the market.

4. *The employment alternatives considered by farm operators.* Previous work with hired farm labor has hypothesized that labor, upon leaving agriculture, goes into a wide variety of nonfarm employments [19, 23]. Consequently, a broad-based measure of nonfarm income per employed worker in the nonfarm sector has been used as the income alternative. This probably applies directly to unpaid family labor also, but it might be argued that operator labor, with its entrepreneurial skills, goes into other entrepreneurial activities. However, the limited evidence available [21] suggests that off-farm migrants as a class tend to work as craftsmen and foremen, operatives, and laborers rather than to engage in other entrepreneurial activities. For this reason the same measure of nonfarm income alternatives was used for farm operators as for the other two components of the farm labor force.

The Statistical Model and Estimation Procedure

The basic statistical model assumes that the level of employment and price of labor for each component of the farm labor force are determined in a market that can be described by a demand and supply equation. These markets are assumed to be interdependent or jointly dependent. Hence, the model is a six-equation simultaneous system.

Nerlove type distributed lags [13, 14] were introduced into each equation, on the assumption that demanders and suppliers of farm labor do not adjust immediately to changing economic conditions but rather spread their adjustment over time. This permits the derivation of both long-run and short-run elasticities.

A trend variable was included in the specification of all demand and supply functions for two reasons. First, it provides a test for secular influences in the labor market that are not explicitly taken into account by the other variables. On the demand side, these would include such factors as the changing quality of the labor force, secular shifts in preferences on the part of employers, and institutional and other changes in the total economy. On the supply side, part of the secular flow of labor out of agriculture may be explained by a gradual change in tastes and preferences for employment in specific industries, the effect of increased schooling on mobility, secular improvements in communication and transportation, or the development and expansion of a more well-integrated economy.

Second, addition of the trend variable improves the specification of the distributed lag model. It has been shown that the coefficient of the lagged dependent variable is especially susceptible to specification bias [1, 10]. If the trend variable picks up the effects of omitted variables that are highly correlated with time (these are most likely to cause problems), the bias should be at least reduced.

Time series data for 1929–61 were used in fitting the model.[4] The data were converted to logarithms for fitting; hence, the estimated coefficients provide direct estimates of the elasticities. Theil-Basmann (two-stage least squares) estimating procedures were used in order to account for the simultaneity in the system.

The basic statistical model is summarized by the following six equations:[5]

$Y_1 = a_1 + b_1 Y_2 + b_2 Y_3 + b_3 Y_5 + b_4 X_2 + b_5 X_6 + b_6 X_4 + b_7 X_9 + \mu_1$ (demand for hired labor)

$Y_1 = a_2 + b_8 Y_2 + b_9 Y_3 + b_{10} Y_5 + b_{11} X_5 + b_{12} X_{10} + b_{13} X_4 + b_{14} X_9 + \mu_2$ (supply of hired labor)

$Y_3 = a_3 + b_{15} Y_4 + b_{16} Y_1 + b_{17} Y_5 + b_{18} X_2 + b_{19} X_6 + b_{20} X_{11} + b_{21} X_9 + \mu_3$ (demand for unpaid family labor)

$Y_3 = a_4 + b_{22} Y_4 + b_{23} Y_1 + b_{24} Y_5 + b_{25} X_5 + b_{26} X_{10} + b_{27} X_{11} + b_{28} X_9 + \mu_4$ (supply of unpaid family labor)

$Y_5 = a_5 + b_{29} Y_6 + b_{30} Y_1 + b_{31} Y_3 + b_{32} X_2 + b_{33} X_3 + b_{34} X_{12} + b_{35} X_9 + \mu_5$ (demand for operator labor)

$Y_5 = a_6 + b_{36} Y_6 + b_{37} Y_1 + b_{38} Y_3 + b_{39} X_5 + b_{40} X_{10} + b_{41} X_{12} + b_{42} X_9 + \mu_6$ (supply of operator labor)

where

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[4] A description and evaluation of the data, plus the data used in estimation, are available from the authors.

[5] Variable identification used in previous published work by the authors has been preserved in order to facilitate comparison by the interested reader.

Y_1 = hired farm labor, measured in year equivalents (USDA estimates);
Y_2 = index of composite wage rates in agriculture, deflated by the consumer price index;
Y_3 = unpaid family labor, measured in year equivalents (USDA estimates of family labor minus the number of farms);
Y_4 = net farm income to family labor per family worker, deflated by the consumer price index;
Y_5 = operator labor, measured as the USDA estimates of number of farms;
Y_6 = net farm income to family labor per farm operator, deflated by the consumer price index;
X_2 = the index of prices received by farmers for all products, deflated by the index of prices paid by farmers for items used in production, except labor ("real" farm prices)[6];
X_4 = hired farm labor, lagged one year;
X_5 = the size of the civilian labor force;
X_6 = Ruttan's [17] index of technology;
X_9 = a trend variable ($1929=1$, $1930=2$, etc.);
X_{10} = nonfarm income per employed worker in the nonfarm sector, multiplied by the percent of the labor force employed and deflated by the consumer price index (this is an estimate of the "expected" average annual income for nonfarm employment);
X_{11} = unpaid family labor, lagged one year;
X_{12} = operator labor, lagged one year; and
μ_i = random error term ($i=1, 2, \cdots, 6$).

Considerable experimenting with the model was done in order to test alternative formulations and to evaluate alternative measures of the economic concepts. The procedure followed was to initiate the work with the markets for unpaid family labor and operator labor, since previous research had dealt with the hired labor component. In this initial work, the markets for unpaid family and operator labor were treated as independent two-equation models. The levels of employment for the other components were introduced as exogenous variables.

After suitable models of these markets were obtained, the markets for hired labor, unpaid family labor, and operator labor were integrated into the six-equation model, which explains simultaneously the price and level of employment for each component of the farm labor force, subject to the set of exogenous variables. In this model, the levels of employment for each component were treated as endogenous variables.[7]

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[6] Because of the serious conceptual and statistical difficulties in measuring the prices of other inputs, especially when they are capital goods, a broad index of the price of non-labor inputs was used and introduced into the model as a deflator of the prices received for farm products. In this way the effect of these price changes is accounted for, but in a rather aggregative way. This is true of each demand equation.

The basic experiments with the models were as follows:

1. *A search for interdependencies among the components.* This was done by introducing separate variables for each of the other components, then omitting those that did not have statistically significant coefficients.

2. *An attempt to identify the role of technology in the labor market.* Considerable work was addressed to this problem with disappointing results. Technology was introduced both as an exogenous variable, as it had been treated in earlier studies, and as an endogenous variable with interrelationships with the price of agricultural labor postulated. None of these experiments was successful.

3. *The estimation of both dynamic (distributed lag) and static models.* This was done by omitting the lagged dependent variable. The evidence in support of the distributed lag hypothesis was reasonably strong, except for operator labor.

4. *The testing of alternative "prices" of farm labor.* Those tested were farm wage rates, net farm income to family labor per family worker, and net farm income to family labor per farm operator. Each was used in estimating the demand and supply equations for operator labor and for unpaid family labor.

Statistical Results

Space does not permit presentation of the statistical results of all these experiments.[8] Table 1 is based on the results generated by a distributed lag model with technology excluded. This model was selected as the "best" on the basis of the authors' judgment of such factors as the consistency of coefficient signs with a priori expectations, the statistical significance of the coefficients, the R^2, and the lack of serial correlation among the calculated residuals.

In general, the statistical results for this model were good. The signs of the coefficients were all consistent with the theory underlying the model. With few exceptions (notably the civilian labor force), the coefficients were also statistically significant at the five percent level or better. The explanatory power of each equation was adequate. Although the magnitude of the coefficients varied among the three components, they were consistent with the underlying economic theory.

However, some problems were encountered with the coefficient of the lagged dependent variable in both the demand and supply equations for

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[7] A market clearing identity of quantity demanded equals quantity supplied was utilized in examining the interrelations among the various components of the labor force.

[8] See the original study [22] for these results.

Table 1. Simultaneous equations estimates of structural demand and supply relations for the three components of the farm labor force, 1929–61, regression coefficients and standard errors

Model	Constant term	"Real" farm prices X_2	Lagged dependent variable[a]	Trend X_9	Civilian labor force[b] X_5	"Expected" nonfarm income X_{10}	Hired labor Y_1	Unpaid family labor Y_3	Operator labor Y_5	Composite wage rates Y_2	Net farm income to family labor per family worker Y_4
Hired labor:											
Demand	2.326	.310** (.085)	.466** (.115) $R^2=.984$	−.044** (.014)	$d'=$ 1.801				−.115 (.090)	−.261** (.061)	
Supply	2.877		.582** (.087) $R^2=.991$	−.081** (.014)	.764** (.132) $d'=$ 2.640	−1.419** (.219)		−.318** (.072)		.649** (.107)	
Unpaid family labor:											
Demand	4.150	.559** (.210)	.860** (.094) $R^2=.958$	−.136* (.050)	$d'=$ 1.728		−1.063* (.488)			−.420* (.191)	
Supply	6.163		.553** (.194) $R^2=.959$	−.105*** (.052)	.237 (.492) $d'=-1.622$*	−1.466* (.755)	− .645* (.367)			.681* (.339)	
Operator labor:											
Demand	.598	.066* (.033)	1.041** (.029) $R^2=.999$	−.028** (.006)	$d'=$ .841**		− .202** (.057)			−.069** (.026)	
Supply	.756		1.036** (.045) $R^2=.999$	−.031** (.010)	.023 (.069) $d'=-$ .867**	− .086** (.029)	− .199** (.063)				.005* (.003)

* Statistically significant at the 5 percent level.
** Statistically significant at the 1 percent level.
*** Statistically significant at the 10 percent level.

[a] X_4 for hired farm labor, X_{11} for unpaid family labor, and X_{12} for operator labor.

[b] d' is the Durbin-Watson statistic for serial correlation among the calculated residuals. No superscript indicates no serial correlation; * indicates an inconclusive test; and ** indicates positive serial correlation.

operator labor. This coefficient was greater than one, although not significantly so.[9] This implies a negative coefficient of adjustment and suggests that there tends to be an over-adjustment to changing economic conditions in the market for operator labor. We view this coefficient with caution, however, because the Durbin-Watson statistic indicates serial correlation in the calculated residuals of both equations, suggesting that the coefficients of the lagged dependent variable might be seriously biased.

Attempts were made to correct this problem both by taking first differences of the variables and refitting, on the assumption that the error term was being generated by a first-order Markov process with a p of one[10] and by using the Durbin-Watson statistic to estimate the serial correlation, introducing this into the model explicitly by an appropriate differencing.[11] Neither procedure improved the statistical results.

Two final comments regarding the statistical results: First, all of the equations in the model in Table 1 satisfy the necessary and sufficient conditions for identification. Second, although intercorrelation among some of the independent variables was high because of the strong trend element in some of these variables, statistically significant coefficients nevertheless were obtained.

Economic Implications

Besides providing quantitative estimates of the demand and supply functions for the three types of farm labor, this study provided a test of the applicability of the theory of demand for a factor of production and the theory of supply of labor to an industry by estimating basically the same model for all three components of the agricultural labor force.

Implications of the results obtained will be presented in two parts: (1) a discussion of the general economic implications, (2) an analysis of the elasticities and their differences among the components. The elasticities derived from the model presented in Table 1 are given in Table 2.

General economic implications

The general economic model set forth for the demand and supply of the components of the farm labor force was quite successful in this study. The coefficient of the price of labor variable was negative and statistically significant in all three demand functions and positive and statistically significant in all three supply functions. Thus, an increase in the farm wage

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[9] Confidence intervals were used for this test in order to make two statistical inference operations at the same time. It was desired to test whether the coefficient was significantly differnt from both zero and one.

[10] See [4] for an explanation of this as a viable alternative.

[11] As suggested by [9]

Table 2. Elasticities of adjustment and short-run and long-run elasticities

Model	Elasticity of adjustment	Price of labor[a]		Real farm prices		Civilian labor force		Nonfarm income adjusted for unemployment		Substitution[b] variable	
		S.R.	L.R.	S.R.	L.R.	S.R.	L.R.	S.R.	L.R.	S.R.	L.R.
Hired labor:											
Demand	.53	−.261	−.492	.310	.585					−.115[c]	.217[c]
Supply	.42	.649	1.545			.764	1.819	−1.419	−3.379	.318	−.757
Unpaid family labor:											
Demand	.14	−.420	−3.000	.559	3.993					−1.063	−7.593
Supply	.45	.681	1.513			.237[c]	.527	−1.466	−3.258	−.645	−1.433
Operator labor:											
Demand	—[d]	−.069		.066						−.202	
Supply	—[d]	.005				.023[c]		−.086		−.199	

[a] Farm wage rate in all equations, except operator labor supply where net farm income to family labor per farm worker was used.

[b] For hired labor demand, quantity of operator labor; for hired labor supply, quantity of unpaid family labor; for all others, quantity of hired labor.

[c] Computed from coefficients not significant at the 5 percent level or better.

[d] Coefficients of lagged dependent variable greater than one, implying a negative elasticity of adjustment, which is inconsistent with the distributed lag hypothesis. Consequently, long-run elasticities are not derived.

rate relative to the price of other inputs in agriculture was associated with a decrease in the quantity demanded of all types of farm labor, other things being equal. On the supply side, an increase in the returns to labor in agriculture relative to nonfarm income was associated with an increase in the quantity of farm labor supplied, other things being equal. In the short run, all of the responses were inelastic. With the exception of operator labor (where different measures of price were used in the demand and supply functions), the quantity supplied was more responsive to changes in the price of labor than the quantity demanded.

The nonfarm income variable[12] had a negative coefficient that was statistically different from zero in all three supply equations and appeared to be a strong shifter in every supply equation. The short-run elasticity was greater than the absolute value of -1 for the hired and unpaid family labor components, implying that a given increase in nonfarm income relative to farm wage rates would result in a proportionally larger decline in the quantity of labor supplied to agriculture, *ceteris paribus*. In addition, this elasticity was more than double that of agricultural wages for the hired and unpaid family labor markets. For operator labor the difference was much greater, implying that members of the agricultural labor force are more responsive to changes in nonfarm income than to changes in returns to agricultural labor. Part of this difference may be due to the fact that a wage rate concept is used in agriculture and an income concept is used for the nonfarm sector; however, the difference is even greater when income concepts are used in both sectors (operator labor supply), indicating that the differences are not simply the result of different measurement concepts.

If wage rates and incomes in the nonfarm sector continue to increase, the supply curves for the three types of farm labor will shift to the left. Since the comparable demand curves are generally more inelastic, these leftward shifts of the supply curves have a sizable impact in raising labor incomes in agriculture.

The real farm prices variable had the expected positive sign and was statistically significant in all three demand functions. The short-run elasticity of quantity of farm labor demanded with respect to real farm prices was less than one. An interesting relationship exists between the magnitude of the real farm prices coefficient and the price of labor coefficient; the larger the coefficient of real farm prices, the larger is the coefficient of the price of labor, and vice versa.

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[12] As constructed, this variable measures the expected income to be received in the nonfarm sector on the assumption that the migrant receives the average compensation in the nonfarm sector if employed and zero income if unemployed. The probability of being unemployed is assumed to be given by the rate of unemployment in the general economy.

Although the technology variable was not used in this analysis because of less than adequate statistical results, this does not mean that technology does not have an impact on the demand for agricultural labor. It has been suggested[13] that adoption of new technology has its impact indirectly through the product market, rather than by reducing the demand for farm labor directly. Assuming that new technology is output increasing, farmers in a purely competitive market will employ new technology and produce a larger volume of output from a given bundle of inputs. When all farmers take this action, farm product prices will fall, *ceteris paribus*, especially in the light of the inelastic demand for farm products.[14] This decline in product prices will result in a leftward shift of the demand curve for farm labor and, consequently, a decline in farm wage rates, other things being equal. Thus, the effect of technology is transmitted to the farm labor market through the relative decline in farm product prices.[15]

The coefficient for the civilian labor force was positive in every case, but statistically significant only in the supply function for hired labor.[16] The response of quantity of labor supplied with respect to changes in the civilian labor force was inelastic in the short run for all three components. This indicates that increases in the civilian labor force, other things being equal, result in a less than proportional increase in the quantity of labor supplied to agriculture.

The trend variable appears to be an important shifter of both the demand for and supply of the three components of the agricultural labor force. The persistent negative coefficient on the trend variable indicates that whatever it is measuring is having a negative influence over time; that is, less labor is being demanded in and supplied to agriculture, *ceteris paribus*.

In the demand equations, the negative coefficient of the trend variable is consistent with the following interpretations: (1) It may be picking up the effects of technological change. This interpretation was not supported by the related statistical analysis, however. (2) It may be reflecting changes in the quality of farm labor over time [see 8]. As members of the farm labor force become better educated and perform more efficiently, fewer of them will be needed, *ceteris paribus.* (3) It may be picking up the effects of a consistent measurement error in some of the variables. Although there is no sound basis for choosing among these interpretations, the last two seem most plausible.

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[13] See [20].

[14] For an analysis of the effect of technology on the demand for agricultural labor, using cross-sectional data, see [24].

[15] Two observations from our unreported work with technology are: (1) that the coefficient of the real farm prices variable tended to be smaller when technology was treated as an endogenous variable, and (2) that there was a rather consistent pattern of a negative coefficient for technology in the demand for hired and unpaid family labor, but a positive one in the demand for operator labor. The lack of a statistically significant coefficient for technology precluded our exploring these implications further.

[16] Farm population was tried as an alternative to the civilian labor force in the supply equations for unpaid family labor and operator labor. The statistical results were even poorer, however.

In the supply equations, the persistent negative coefficient of the trend variable is also subject to a number of interpretations: (1) It may be measuring the effects of a stronger preference for nonfarm employment, not only because of differences in relative incomes, but also because of better working conditions, shorter hours, or more prestige. (2) It may be picking up aspects of industrialization not included in the wage variables, e.g., availability of jobs, improved transportation systems, and improved communications. (3) As in the demand equations, it may be measuring the effects of consistent measurement or specification errors in some of the variables. (4) It may reflect the effect of increased schooling on mobility [see 8]. Again, we have no sound basis for choosing among these alternatives.

The coefficients of the substitution variables were negative in each equation and were statistically significant except in the hired labor demand equation. This indicates that an increase in the quantity of one component of the agricultural labor force will be associated with a decline in the demand for or supply of some other component, *ceteris paribus.* On the demand side, this implies that the components of the agricultural labor force may be substituted for one another in the production process; on the supply side, it indicates that members of the various components are to some extent mobile among the components of the agricultural labor force.

In general, the statistical results tend to support the distributed lag hypothesis, except for operator labor, where the coefficient of the lagged dependent variable is slightly, but not significantly, greater than one.[17] All of the coefficients for the lagged variables were significantly different from zero at the one percent level. This implies that there is a lag in the response to economic stimuli by members of the agricultural labor force.

Elasticities and differences among components

The economic implications of the elasticities obtained will now be discussed, together with some tentative explanations of the differences among the components of the agricultural labor force. The discussion will center around the coefficient of adjustment and the elasticities for the price of labor variable, the real farm prices variable, the civilian labor force variable, the nonfarm income variable, and the substitution variables.

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[17] For a discussion of the limitations of the statistics used in evaluating the distributed lag hypothesis in the context of a study similar to the present one, see [23], especially pp. 547–549.

The elasticities of adjustment found in this study ranged from .53 in the hired labor demand equation to .14 in the unpaid family labor demand equation. This means that in the demand for hired labor the long-run elasticities are slightly less than twice the short-run elasticities. As a consequence, it would take about four years to remove 95 percent of the initial disequilibrium if no further disequilibrating changes occurred. An elasticity of adjustment of .14 implies that (1) the long-run elasticities are approximately seven times as great as the short-run elasticities in the demand function for unpaid family labor, and (2) it would take almost 20 years for the initial disequilibrium to work itself out, assuming no other changes take place.

A negative coefficient of adjustment was obtained for both the demand and supply equations in the operator labor market, implying that there will be movement away from equilibrium if no changes take place in the economic variables. Such a conclusion would indicate considerable instability in the operator labor market. One possible reason for this theoretically inconsistent result is that the distributed lag model specified for the operator labor market is not correct. The model used assumes that the movement towards equilibrium follows an asymptotic path with the largest proportion of disequilibrium removed in the first period. An alternative approach may be to assume that the movement towards equilibrium follows a logarithmic normal distribution with the maximum effect occurring some time after the disequilibrating change takes place [13]. To pursue this and other approaches would be a study in itself.

The estimated elasticities of adjustment present an interesting pattern among the components of the agricultural labor force. For the purpose of this analysis, the assumption is made that the coefficient of adjustment for both the demand and supply of operator labor is zero, since the coefficient of the lagged dependent variable was not significantly different from one. On the demand side, the coefficient of adjustment is largest for the hired labor market, about one-fourth as large in the unpaid family labor market, and essentially zero in the operator labor market. This is consistent with the hypothesis that the hired labor component is the marginal labor input in the production process and, hence, is the one that farmers manipulate most readily. Also, it is the only farm labor input that receives a direct payment. In a sense, unpaid family labor is also a marginal component, but since it is directly attached to the farm and receives no fixed payment, it appears that the farmer does not respond in his use of this component to changes in economic stimuli as rapidly as for hired labor.

As a demander of his own labor, he will be least responsive to factors that would influence the use of his own labor.

On the supply side, the coefficients of adjustment are approximately equal for hired and unpaid family labor. This similarity, in part, suggests that these two components have similar alternative opportunities. It is also to be noted that they have similar demographic characteristics, such as age and education; that is, both components consist of a large proportion of young people of school age. Since one alternative open to them is to drop out of the labor force entirely, they are quite responsive to economic stimuli in offering their labor services. Operator labor, on the other hand, is older, has fewer alternative opportunities and a much stronger commitment to agriculture; consequently, the supply is much less responsive to economic stimuli.[18]

Short-run demand elasticities with respect to farm wage rates ranged from −.069 for operator labor to −.681 for unpaid family labor. This means that a ten percent increase in farm wage rates would result in a .7 percent decrease in the quantity of operator labor demanded and a 6.8 percent decrease in the quantity of unpaid family labor demanded, other things being equal. Short-run supply elasticities with respect to farm wage rates range from .005 for operator labor to .681 for unpaid family labor. The ranking is the same for both demand and supply elasticities. Based on the composition of the agricultural labor force, the most important component (operator labor) has the lowest elasticities, while the least important component (unpaid family labor) has the highest elasticities.

The long-run supply elasticities with respect to farm wage rates for both hired and unpaid family labor are equal to approximately 1.5, which is to be expected since hired and unpaid family labor are similar in demographic characteristics. The long-run demand elasticities are very diverse —about −.5 for hired labor and −3.0 for unpaid family labor.

With respect to nonfarm income, the supply elasticities are again about the same for unpaid family and hired labor, both in the long-run and the short-run; but for operator labor the short-run supply elasticity is considerably less. This again supports the conjecture that hired and unpaid family labor have approximately the same alternatives, whereas operator labor has a stronger commitment to agriculture and hence is not as responsive to changes in nonfarm income.

The elasticities of the substitution variables present an interesting pattern. In the short-run, hired labor appears to be a perfect substitute in the demand for unpaid family labor (elasticity is −1.063). In the demand for operator labor, however, hired labor is still a substitute, but the substitution is not perfect (elasticity is −.202). Operator labor tends to substitute in the demand for hired labor (elasticity is −.115), but the relationship is weak—the coefficient is not statistically significant, although it is larger than the standard error. These results add further support to the hypothesis that the components of the agricultural labor force are interchangeable in the production process, particularly hired labor for unpaid family labor.

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[18] This result is consistent with Clawson's findings [2] that the bulk of the change in the operator labor force has not come about by a shifting of the operators, but rather by a decline in the rate of entry into farming.

On the supply side, the short-run elasticities of the substitution variable are also quite informative. The magnitude of the elasticities provides a further indication of substitutability among the components. For example, the elasticity of the quantity of hired labor in the supply of unpaid family labor equation is −.645, implying that a 10 percent change in the quantity of hired labor would be accompanied by a 6 percent change in the opposite direction in the quantity of unpaid family labor supplied, *ceteris paribus*. Part of this change in the quantity of hired labor may be caused by a shift of workers from the unpaid family labor component to the hired labor component, or vice versa.

The long-run elasticities provide additional evidence of substitutability among the components of the farm labor force, particularly hired labor for unpaid family labor, adding support to the conjecture that unpaid family labor moves into the hired labor component or out of agriculture in the longer run. Even in the long-run, the substitution variables have elasticities that are less than −1 in absolute terms, implying that unpaid family labor does not substitute perfectly for hired labor and that operator labor is not a perfect substitute for hired labor in the production process.

Policy Implications

Government policies designed to solve some of the income problems in agriculture may now be evaluated on the basis of the results of this study. The discussion will center around the price support program vs. monetary and fiscal policy, a minimum wage law in agriculture, and efforts to improve the labor transfer process.

Given the inelastic nature of the supply and demand curves in the short run, any economic force that shifts either curve, even slightly, will have a significant impact on the wage rate but a relatively smaller impact on the quantity of labor used. In the long run, when relationships are more elastic, the major impact of changing economic forces would be on the quantity of labor used rather than on wages. Consequently, in the short run, the impact of farm price support programs would be to shift the demand curves for labor to the right,[19] resulting in a higher wage rate but not much additional employment. The impact of monetary and fiscal policies that serve to raise the level of nonfarm income and lower the level of unemployment (both are included in X_{10}) would have the effect of shifting the supply curve of labor to the left, thus giving a higher wage rate for a smaller number of people employed in agriculture. In the longer run, the price support program would tend to raise wage rates only slightly but would lead to a higher level of agricultural employment, whereas monetary and fiscal policy would raise wage rates relatively more but would lead to a lower level of agricultural employment, *ceteris paribus*.

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[19] Farm support programs that lead to higher farm prices result in an increase in the demand for labor, other things being equal.

If there were an oversupply of labor in agriculture, the price support program would tend to aggravate the labor adjustment problem, particularly in the long run. However, increases in nonfarm income, in the long run, would result in a sizable shift of labor out of agriculture and a higher wage rate for those that remain. Given a goal of higher incomes in agriculture, such a situation would be desirable.

The minimum wage law in agriculture can also be analyzed with the aid of this study. If the farm wage rate were raised above its equilibrium level, the impact would be similar to that of the price support program for agricultural products. The higher wage rates would decrease the quantity of labor demanded and increase the quantity of labor supplied, thus making the problem of underemployment and labor adjustment in agriculture even more serious. To the extent that the farm wage rate is a reasonably good proxy measure of the price of unpaid family and operator labor, the impact of the minimum wage law would be greatest on the unpaid family labor component, which has the highest short- and long-run elasticities, and smallest on the operator labor component, which has the most inelastic relationships.[20]

The fact that people lag in response to economic stimuli also has policy implications. Differences in the speed of response may have an important bearing on the outcome of a particular change or policy variable. For example, this study shows that farmers respond much more rapidly to economic stimuli affecting the demand for hired labor than to those affecting the demand for unpaid family labor, even though the elasticities of demand are greater for unpaid family labor. Policy measures should recognize these differential responses, both as a means of obtaining more efficient results from given policy measures and in terms of their implications for the goals of policy measures.

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The Contribution of Foreign Assistance to Agricultural Development*

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In recent years, national and international aid agencies have allocated a considerable amount of resources to the agricultural sector of less developed countries. The purpose of the research reported in this article is to determine whether these resources have made an identifiable contribution to the recipients' agricultural production. To answer this question, a cross sectional sample of 13 major aid receiving countries was investigated. Changes in agricultural production between two three-year periods (1960–1962 and 1964–66) were statistically related to the increase in land area cultivated, the increase in labor employed, and agricultural aid per hectare. The form of the statistical relationship was derived from a Cobb-Douglas production function. Aid to agriculture was subdivided into three categories: (a) aid in financing agricultural inputs, such as fertilizer; (b) technical assistance; and (c) aid to finance facilities to produce agricultural inputs (e.g., fertilizer plants). The analysis showed that there was a statistically significant relationship between aid-financed inputs and agricultural output. This type of aid explained nearly one-third of the average 15 percent increase in agricultural output experienced by the 13 countries. On the other hand, there were no statistically significant relationships between the other two types of aid and agricultural production; but this is not surprising, considering the short period of time investigated.

THERE can be little doubt that agricultural development is one of the major tasks facing the less developed nations. The dimensions of the world food problem have been described vividly by the President's Science Advisory Committee [6]. More generally, it has been argued effectively that agricultural development is a necessary prerequisite to general economic development [2, 3].

Recognizing the importance of agricultural progress, the United States and other advanced nations have channeled a major portion of their foreign development assistance into agricultural development and food aid programs [1, p. 23]. Little quantitative analysis, however, is available regarding the effectiveness of foreign assistance to agricultural development, and that which is available is directed primarily toward an evaluation of food aid and related programs [7, 10].

The purpose of this paper is to report on research designed to measure the impact of foreign economic assistance on agricultural output in the less developed nations. Attention is focused on the 13 less developed

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countries that were major recipients of United States foreign aid during 1962–1965. However, the foreign assistance flows considered include not only the agricultural assistance given by the United States Agency for International Development but that of the International Bank for Reconstruction and Development, the International Development Association, and the Inter-American Development Bank as well.[1]

Foreign Assistance to Agriculture

Foreign aid to agricultural development can take several forms: (1) foreign exchange for the importation of agricultural inputs, (2) capital development projects, (3) local currency allocations to the agricultural sector, and (4) technical assistance activities.[2]

For purposes of this study, we were interested in segregating aid flows that can be expected to yield output increases in the short run from those that are directed at improving the social and economic infrastructure in the agricultural sector and thereby can be expected to yield longer term results. Consequently, capital project assistance, such as that directed toward providing credit, was segregated from assistance to projects with a longer maturity. The resulting categories are:

Type I—High Impact Assistance: Agricultural assistance directed toward short-run increases in output. Included are foreign exchange for the importation of agricultural inputs (e.g., fertilizer and seed), local currency allocations to agriculture, and capital development projects such as credit, mechanization, and land preparation.

Type II—Long-Term Capital Development Assistance: Assistance to finance projects with long-term yields. Included are capital development projects designed to improve the agricultural infrastructure, irrigation projects, and projects designed to increase domestic production of agricultural inputs such as fertilizer.

Type III—Technical Assistance: Foreign assistance designed to help build the basic institutions and develop the human skills required for sustained economic, social, and political development.[3]

Data on each type of foreign assistance flow for each nation are presented in Table 1. The assistance flows shown represent only funds actually received and expended during 1962–1965; thus, to some extent, they also reflect commitments and authorization of previous years.

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[1] The foreign agricultural assistance of other donor nations, not channeled through these international organizations, is excluded because of a lack of comparable expenditure data. However, this omission does not appear serious in the major U.S. aid recipient nations studied.

[2] P.L. 480 food shipments are not considered to be aid to agricultural development; only those local currency balances actually expended for agricultural development projects are treated as agricultural assistance in this paper.

[3] This concept of technical assistance is the same as that of A.I.D. [1, p. 250].

Table 1. Agriculture assistance expenditures, 1962–1965

Nation	Type of assistance			
	I	II	III	Total
	thousand U. S. dollars			
Brazil	45,845	150	16,970	62,965
Chile	21,284	2,997	1,480	25,761
Colombia	20,431	0	3,683	24,114
India	153,857	65,018	6,012	224,887
Korea	97,142	9,250	1,068	107,460
Morocco	17,629	16,800	930	35,359
Pakistan	207,220	92,769	9,642	309,631
Peru	14,005	11,643	4,060	29,708
Philippines	3,097	7,500	1,379	11,976
Taiwan	19,659	8,293	1,744	29,696
Thailand	6,788	11,739	2,623	21,150
Tunisia	25,144	8,550	2,765	36,459
Turkey	15,918	6,568	6,945	29,431
All 13 nations				
Total	648,019	241,277	59,301	948,597
Average	49,847	18,559	4,561	72,969
Percent of total	68.31	25.43	6.25	100.00

Sources: Agency for International Development, *Counterpart Funds and A.I.D. Foreign Currency Accounts,* 1962, 1963; *Operations Report,* 1962–1966; and *Technical Assistance Project Activity Status,* 1962–1966.

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International Bank for Reconstruction and Development, *Statement of Loans,* 1962–1966.

International Development Association, *Statement of Development Credits,* 1962–1966.

On the average, each nation received nearly 73 million dollars in foreign agricultural assistance during 1962–1965, of which more than two-thirds was Type I aid. The proportions vary, however, as Korea received an agricultural assistance package composed of over 90 percent Type I assistance, while both the Philippines and Thailand received less than one-third of their agricultural assistance in that form.

Procedure

The value of agricultural output during 1960–1966 was computed from data provided by the Regional Analysis Division of the United States Department of Agriculture.[4] Computations were those for which comparable land area and production data were available for those years. In general, neither tree crops, such as coffee and olives, nor livestock products were included. The proportion of total agricultural output included varies, depending upon the weight of excluded crops, such as coffee, in the total value of agricultural output. Land area data comparable with the output data and employment in agriculture (economically active population) were also collected for the 13 nations [3, 4, 5].

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[4] In computing the value of crops included in the value of output production, the U.S.D.A. uses 1957–1959 average prices at the farm level; to the extent possible, commodities are combined on a calendar year basis. Most of the basic output data are available in [11, 12, 13, 14].

A Cobb-Douglas production function was assumed as the form of the basic relationship between output, land, labor, and agricultural investment, both domestic and foreign. Quantitative estimates of the impact of foreign assistance flows on agricultural output in the 13 nations were obtained by using a multiple regression model of the form

$$Y_i = b_0 + \sum_{j=1}^{5} b_j X_{ji}$$

where: Y = the percentage increase in the value of crop production between the periods 1960–1962 and 1964–1966. Constant 1957–1959 prices were used.[5]

X_1 = the percentage increase in land area employed in crop production between the periods 1960–1962 and 1964–1966.

X_2 = the percentage increase in the number of economically active people in agriculture between 1961 and 1965.[6]

X_3 = high impact foreign assistance per hectare of cropland during the period 1962–1965 (Type I aid).

X_4 = long-term capital development assistance per hectare of cropland during the period 1962-1965 (Type II aid).

X_5 = technical assistance per hectare during the period 1962–1965 (Type III aid).

Lack of information about domestic agricultural investment (both public and private) and about agricultural capital stock required the assumption that domestic net investment in crop production was allocated between that associated with changes in land area and that associated with foreign assistance flows.[7] Thus, in the model, one part of net domestic investment in crop production is assumed to be proportional to changes in land area devoted to crop production, and the remaining net domestic investment in agriculture is assumed to be related to foreign assistance flow. As a result, the regression coefficients associated with the aid variables must be interpreted as reflecting the impact of foreign assistance and related net domestic investment.[8] This interpretation is consistent with the philosophy of "self-help" underlying the foreign assistance program in that foreign assistance is utilized to redirect priorities and stimulate host country activities in priority areas [1, pp. 2–3].

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[5] For India and Pakistan, 1966 data were not utilized because of the serious drought these nations experienced in that year.

[6] Economically active is defined to include all persons engaged in an economic activity, whether as employees, own-account workers, salaried employees, or unpaid workers assisting in the operation of a family team. Comparable data were not available for each nation for the entire period 1961–1965. Thus, in some instances, it was necessary to extrapolate from the data available to obtain an estimate for a given year.

[7] This approach neglects what Phillip Raup has termed accretionary capital formation. However, by definition, accretionary capital formation is a long term phenomenon and hence is not significant over a four-year period [11].

This study does not take into account the impact of foreign assistance on goals other than total output. It is important to note, however, that social goals such as income distribution and popular participation in decision making may also be sought through foreign assistance programs. Since these contributions of foreign assistance have not been included, the results will understate the total contributions of aid.

The Impact of Foreign Agricultural Assistance

The regression equation was estimated in three forms:

$$(1)\ Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3$$
$$(2)\ Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4$$
$$(3)\ Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_5X_5$$

The regression coefficients for the aid variables are provided in Table 2. The coefficients associated with land and labor were not significant at the .05 level; however, at the .10 level, land was significant in equations 1 and 3.

The negative coefficients of the Type II and Type III aid variables are not unexpected. Neither capital projects nor technical assistance can be expected to yield significant output results over a four-year period. Moreover, current output may be reduced as domestic investment is diverted to help finance the long-term capital and technical assistance projects.

The Rate of Return on Type I Assistance

Agricultural production in the 13 countries increased by an average of 15 percent between 1960–1962 and 1964–1966; that is, from $113 to $130 per hectare. During the same period, the average Type I agricultural assistance was $8.80 per hectare. From equation 1 of Table 2 we see that, on the average, each dollar of Type I assistance was associated with a .54 percent increase in output per hectare. Thus, on the average, Type I assistance and related capital formation contributed to a 4.75 percent increase in output (8.80 × .54 percent) or nearly one-third of the total increase of 15 percent.[9]

In calculating the rate of return of each dollar of Type I agricultural

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[8] See Appendix A for the derivation of the statistical model from the Cobb-Douglas production function.

[9] In more specific terms, the elasticity of Y with respect to Type I assistance is 4.75 at the mean values.

Table 2. Estimates of regression coefficients for the aid variables

Equation form	R^2	F	Aid variable coefficients		
			I	II	III
(1) $Y = b_0 + \sum_{1}^{3} b_i X_i$	.55	3.67*	.536* (.198)		
(2) $Y = b_0 + \sum_{1}^{4} b_i X_i$	.62	3.32*	.624* (.205)	−.874 (.700)	
(3) $Y = b_0 + \sum_{1}^{3} b_i X_i + b_5 X_5$	.66	3.81*	.549* (.184)		−3.22 (2.06)

* Significant at the .05 level.

assistance, we must calculate the accumulated increase in output associated with the aid flow over 1961–1965. Thus, we know that average output per hectare in 1965 (0_4) was $5.37 larger than in 1961 (0_0) or $.61 for each dollar of Type I assistance made available during the period:

$$\phi = 0_4 - 0_0 = (0_1 - 0_0) + (0_2 - 0_1) + (0_3 - 0_2) + (0_4 - 0_3)$$

The cumulative increase in output (0^*) over 1961–1965 is calculated as follows:

$$0^* = (0_1 - 0_0) + (0_2 - 0_0) + (0_3 - 0_0) + (0_4 - 0_0)$$

If we assume that the aid flow and the increase in output occurred evenly over the four-year period, 0^* would equal $13.42 and the rate of return on $8.80 of Type I assistance would exceed 52 percent. Other assumptions are, of course, possible; for example, in the most pessimistic case, the total increase in output occurs only in 1965. Thus $0^* = \Phi$, and the total increase in output over the four-year period would be only $5.37 on an investment of $8.80. The rate of return would be negative in this case.

Conclusions and Implications

The major conclusion of the study is that high impact (Type I) foreign assistance to the agricultural sectors of the 13 nations studied was associated with substantial increases in agricultural output. The lack of domestic investment data restricts the usefulness of a rate of return calculation, which should include consideration of the domestic investment associated with Type I assistance. However, Type I foreign assistance is primarily directed at current bottlenecks in the agricultural economy, and it is likely that fewer domestic resources would have been directed to agriculture in the absence of foreign aid, while those that were would have been used less efficiently. Thus, a large portion of the additional output is properly attributed to the aid.

The lack of association found between output and both technical assistance and long-term capital flows reflects a series of factors. Type I assistance in the form of credit and agricultural requisites, including fertilizer and pesticides, has a quicker pay-off than technical assistance and capital projects. Thus, an analysis that considers only a four-year period will no doubt overlook output increases derived from aid activities with a longer maturity. In addition, the analysis does not consider technical and long-term capital assistance provided during the years preceding 1961, both of which may account partially for the impact of Type I assistance on current output levels.

Perhaps equally important, foreign assistance to the agricultural sector is not always directed at output goals. Social goals, such as income distribution and popular participation in decision making, also may be sought. Therefore, the use of output as the only indicator of aid effectiveness presents a somewhat biased result. This is especially true in view of the fact that technical assistance is the aid instrument most often used to attain non-economic agricultural sector goals.

A more pessimistic view, however, suggests that technical assistance and long-term capital projects are initiated in non-priority nations, or nations having limited output potential given current agricultural policies and programs. Even though each nation included in this study is a major aid recipient, the possibility still exists that technical assistance and long-term capital projects in agriculture may have been directed to those nations that had not formulated and implemented effective overall programs for agricultural development. Technical assistance and certain capital projects may have been made available to those countries in order to "maintain a presence" in agriculture until effective agricultural programs could be implemented.

These conflicting interpretations of the results of our analysis make it abundantly clear that its relatively simple approach cannot provide a complete explanation of the effects of foreign assistance on agricultural development.[10] More research is required to extend the time period of the analysis and to incorporate other factors that may explain changes in agricultural production. It is particularly necessary in this connection to investigate the quantity of domestic inputs into agriculture that are associated with aid. Furthermore, it would be useful to determine whether the response of domestic inputs is related to objective factors such as the type of aid, the recipient country's level of economic development, and the type of political organization. If such a relationship exists, it would be possible to design "optimal" aid programs for each country.

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[10] Thus, the R^2's in Table 2 are not as high as would be desired. On the other hand, they are statistically significant.

The type of research that is needed requires extensive data, which can be generated only by detailed case studies. Primary data collection is specifically required to determine the quantities of domestic inputs into agriculture. The secondary sources employed in this paper simply do not contain the necessary information.

Despite these data limitations and the short time span investigated, some conclusions for foreign assistance programming can be drawn. Specifically, it has been shown that aid to finance fertilizer and other agricultural inputs can be expected to yield a rather large return, and this return must be considered to be the opportunity cost of resources devoted to longer term agricultural projects. Even when this opportunity cost is considered, however, the results of this study do not imply that there should be a reallocation of agricultural aid. Surely we must continue to encourage long-term agricultural investments that are designed to increase the social and physical capacity of the less developed nations to absorb and generate resources represented by fertilizer and improved varieties. But we must recognize that there appears to be considerable scope for increased agricultural output based upon the provision of these new inputs within the existing institutional and economic framework of the less developed countries.

Appendix A

This Appendix provides a theoretical rational for the preceding statistical analysis. Following are the variables and assumptions required by the statistical analysis.

The variables:

O—agricultural output
L—land employed in agricultural production
M—labor employed in agriculture
C—the agricultural capital stock

Agricultural output is a function of the inputs:

$$O_i = f_i(L_i, M_i, C_i). \tag{1}$$

The subscripts indicate reference to country (i).

Equation (1) is completely general in the sense that every country could have a completely different production function. While it may be realistic to make such an assumption, it is impossible to estimate the parameters of various functions from cross-sectional data. Since we are constrained by data limitations to a cross-sectional analysis, we must make the simplifying assumption that the production function is the same for every country. The general form of the production function is:

$$O_i = f(L_i, M_i, C_i). \tag{2}$$

Assume that the function in (2) has the form of a Cobb-Douglas production function.

$$O_i = AL_i^aM_i^bC_i^c. \tag{3}$$

This function can be expressed in terms of changes in inputs and outputs by taking logarithms of both sides and then taking the total derivative.

$$\frac{dO_i}{O_{oi}} = \frac{dA}{A} + a\frac{dL_i}{L_{oi}} + b\frac{dM_i}{M_{oi}} + c\frac{I_i}{C_{oi}}, \tag{4}$$

where I_i is the change in capital stock.

Net investment in agriculture (I_i) may be divided into three components: (a) that associated with aid, (b) that associated with changes in land area under cultivation, and (c) an autonomous component.

$$I_i = B_i + l_i dL_i + m_i I_{ia} \tag{5}$$

where I_{ia} is the aid invested in country i's agricultural sector.

In deriving the function to be statistically estimated, we have made the following assumptions about the parameters in equation (5):

$B_i = 0$; that is there is no autonomous component of domestic investment. Domestic investment is associated either with changes in land under cultivation or with aid.

l_i is proportional to the initial capital stock on the land. That is, $l_i = p_i k_i$, where k_i is the capital stock per initial unit of land; $k_i = C_{oi}/L_{oi}$

The parameter p_i is the same in every country, $p_i = p$. With these assumptions, substituting (5) into (4) and k_iL_{oi} for C_{oi}, we have

$$\begin{aligned} \frac{dO_i}{O_{oi}} &= \frac{dA}{A} + a\frac{dL_i}{L_{oi}} + b\frac{dM_i}{M_{oi}} + c\frac{[pk_i dL_i + m_i I_{ia}]}{k_i L_{oi}} \\ &= \frac{dA}{A} + (a + pc)\frac{dL_i}{L_{oi}} + b\frac{dM_i}{M_{oi}} + c\frac{m_i}{k_i}\left(\frac{I_{ia}}{L_{oi}}\right). \end{aligned}$$

The parameters in equation (6) may be estimated statistically if it can be assumed that the ratio m_i/k_i is the same in every country. Such an assumption would require that m, the constant of proportionality between net investment and aid, be higher in countries that have a larger initial stock of capital per unit of land (k). The assumption does not require that both m and k be the same in all countries. Since the factor of proportionality between aid and net investment (m) is an indication of self-help, the assumption requires that self-help be greater in countries with a larger capital stock per unit of land.

With the necessary assumptions, equation (6) shows that the percentage change in agricultural output will be related to the percentage change in land area under cultivation, the percentage change in labor employed in agriculture, and the amount of foreign aid per unit of land initially under cultivation. In the statistical regression equation, the constant term represents the autonomous change in agricultural production not represented by changes in factor inputs. The coefficient of the percentage change in land area is the sum of the elasticity of output with respect to changes in land and the product of the elasticity of output with respect to capital and the factor of proportionality between changes in land area and net investment. The coefficient of the percentage change in labor inputs is the elasticity of output with respect to labor. Finally, the coefficient of the aid per hectare variable is the product of the elasticity of output with respect to capital inputs and the ratio of (a) the constant of proportionality between net investment and aid and (b) the initial capital stock per unit of land. This coefficient thus measures the response of output to additional capital inputs and the relationship of total investment to aid.

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Theories Explaining the Persistence of Low Resource Returns in a Growing Farm Economy*

LUTHER G. TWEETEN

Low rates of return (defined as earnings below opportunity costs) on farm resources have long been considered a major farm problem and one justification for government commodity programs. This paper first analyzes influences (such as economic growth, inflation, and technology) that generate disequilibrium and low returns. But the major issue analyzed is why farm disequilibrium persists after an extended period of full national employment, a strong national economy, an expansion of the aggregate farm plant, and a slow growth of farm productivity in the 1960's. The fixed resource theory, the increasing returns to size theory, and the imperfect competition theory are examined to explain persistence and permanency of disequilibrium and low returns. The fixed resource theory explains low returns as a labor fixity problem and suggests that the problem is either nonexistent or temporary. The increasing returns to size theory points to an extended duration for the low returns problem as long as the large majority of farms continue to operate on uneconomic size units. Finally, the imperfect competition theory depicts low returns as virtually permanent, given the economic structures of the farm and nonfarm sectors.

LOW rates of return (defined as earnings below opportunity costs) on farm resources, long considered a major farm problem, have been explained mainly by technological change and asset fixity. The aggregate productivity index for farms was the same magnitude in 1966 as in 1961 and only 4 percent greater in 1968 than in 1960 [24, p. 16]. The farm economy was expanding—the volume of production inputs increased 11 percent from 1960 to 1968. Despite slowing of productivity growth, a strong national economy that has grown steadily for eight years, comparatively low rates of national unemployment, and expansion of the aggregate farm plant, the farm economy continues to be depressed as measured by low returns on resources [21, 25]. Depressed returns persist despite considerable time to overcome asset fixity and shifting of supply (the shift measured by productivity) to the right at a slower rate than demand.[1]

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[1] The supply curve can shift from changes in input prices as well as from changes in productivity. Since input prices have risen sharply, ceteris paribus, this has shifted the supply curve to the left, and strengthens my argument that supply has shifted less rapidly than demand to the right. Some might also argue that the change in the productivity index reflects a movement along the supply curve (or production function) rather than a shift in the supply curve. Such an association should show up in a correlation between changes in the parity price ratio and changes in the productivity index. I have been unable to detect statistically any such association from empirical data.

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young and very old workers who tend to have low earnings and fewer opportunities for outside employment contributes to a low opportunity price at which to salvage farm labor. The median age of farmer operators was approximately 51 years in 1960, when 5.3 percent of the total farm labor force were between 14 and 17 years of age and 14.7 percent were age 60 and over. For the same age groups in urban employment, the respective percentages were 3.0 for younger group and 9.7 for the older group.

Analyses show that the farming industry receives a low return on resources when all farm resources are valued at their opportunity price [15, 21, 25]. It was found that gross farm income failed to cover all costs of farming when farm resources were valued at their opportunity price, that is, what they would likely earn if employed elsewhere.[4] The problem of low returns on farm resources appears to be real. We must look beyond the opportunity price to explain the difference between actual returns and the acquisition price of farm resources.

The transfer cost hypothesis

Wage rates in economic equilibrium differ because of transfer costs. The wage rate in agriculture must drop below the opportunity value less transfer cost to justify economically the transfer of labor from agriculture. The opportunity price P_O less transfer cost is designated P_T in Figure 1. Transfer costs are unlikely to be a large part of potential earnings in the nonfarm sector. If moving costs are $500 and the migrant will earn $5,000 for 20 years in new employment, moving costs are only .5 percent of future earnings. Thus, monetary transfer costs appear to be too small to explain the discrepancy between the earnings of comparable farm and nonfarm resources. Transfer costs may loom large, however, for individuals who, because of old age, have few years of productive employment ahead, who must search long and perhaps unrewardingly for a new job, or who have little capital or credit base on which to support the transition.

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[4] The USDA study [25] compared "net farm income from farming and the amount of income or returns that comparable resources would earn in other employment. This comparison indicates whether or not farmers' resources are earning as much in farming as they could be expected to earn in the nonfarm economy" [25, p. 33].

Farm resources such as fertilizer, protein feeds, and pesticides that were not in excess supply were valued at acquisition price. Farm land was valued in several alternative rates, one of which assumed that the farmer would sell his farm and invest the amount received in common stocks, on which he would receive dividends and capital gains. Labor was valued at the urban wage rate adjusted downward for the age, schooling, and sex ratio of farm workers vis-a-vis urban wage earners. The assumption is that at the margin farmers can sell their specialized capital equipment to other farmers but salvage their excess labor and financial equity in the non-farm sector.

The endodermal hypothesis

The price that induces outmovement of labor from agriculture may be considerably lower than P_T for workers who value highly the farm way of life. Brewster labeled this the "endodermal" hypothesis explaining the farm problem [2, pp. 129ff]. If alternate employment means leaving the community, the farmer may accept a low return for his labor rather than leave relatives and friends. The reservation price of farm labor is labeled P_R. It is the price below which the farm labor earnings must fall before alternative employment will induce release of labor from agriculture, given potential earnings in nonfarm employment, transfer cost, psychic satisfaction from farming, and expectations of future farm earnings and of living in the city.

Given favorable economic conditions such as immediately followed World War II and indicated by MVP_1, farm employment X, and labor earnings P_A, suppose that prices received by farmers fall because supply is increasing faster than demand. This can occur because government supports are curtailed, because of favorable weather for crops, or because demand contracts due to a depressed national economy or declining farm exports. If farm labor responded strictly to opportunity costs in the absence of transfer costs and special values on farm employment, then outmovement of farm labor would begin with the drop of the marginal value product just below MVP_2 (Figure 1). Reduction of farm employment would begin with a drop in the marginal value product to just below MVP_3 if transfer costs are included. And the marginal value product would need to fall below MVP_4 to induce lower farm employment when the psychic satisfactions of the farm way of life, imperfect knowledge, and other factors reflected in P_R are considered. The marginal value product could range from MVP_1 to MVP_4 without changes in farm employment. The farm economy would be in equilibrium" in a period requiring fewer resources only if all farm labor were valued at its reservation price, P_R. Use of any other price, P_A, P_O, or P_T, would show that the gross income in agriculture would not cover all farm costs.

Effects of resource fixity on farm output and earnings

Before appraising the actual role of fixed resource theory in explaining persistence of low returns, it is necessary to examine the fixity of farm production resources in addition to labor. How fixed are farm resources? To answer this question, it is useful to divide farm resources into five categories: (a) financial resources, (b) operating capital, (c) durable capital, (d) real estate, and (e) labor. It is also necessary to consider two basic dimensions of fixity—durability of resources and the relationship of the marginal value product to the four prices listed in Figure 1.

Financial resources such as currency, bank deposits, and bonds are quite readily transferable to nonfarm investments and should cause no extended problems of fixity and attendant low returns.

Operating capital such as fertilizer, fuels, seed, repairs, pesticides, and hardware supplies have generally low opportunity prices for salvage, once committed to farming. These supplies, purchased on the basis of an expected product price, are likely to be used even if the product price falls sharply during the production period. But the inputs are consumed quickly, most in one production period. Hence the farmer can correct his error by purchasing fewer operating capital inputs in the next production period. Furthermore, the farm MVP's for these inputs have tended to lie above acquisition prices. It follows that operating capital poses no real problem of input fixity.

Durable capital items, such as farm machinery, give off services over an extended period and have low salvage value outside of the farming industry. USDA estimates [22, p. 57] show an annual depreciation rate for farm machinery of 10 percent, although the services given off fall less than 10 percent per year from a given stock. Even if services decline at half this rate, without adding to the stock of machinery the machinery input would fall nearly one-fifth in four years—hardly a serious degree of fixity. Again, data conflict on where the marginal value product of machinery lies in relation to acquisition price. The Tyner-Tweeten study indicates machinery is not in excess supply [18]. Farm produced durables, such as breeding stock, would seem not to create serious problems of fixity because the acquisition price varies proportionately with farm economic conditions and because they can be salvaged at slaughter prices.

The fourth input category, farm real estate, is durable and has a low opportunity price for salvage in nonfarm uses (except around cities). Its degree of fixity is so great, however, that its price is determined by economic conditions within agriculture. Since land price does not determine farm output, it would be unwise to blame excess capacity and associated low returns in farming on the land price. It will become more apparent later in this report that low returns on farm land arise because farmers pay "too much" for land.

Thus, because the input life is short, or because the MVP exceeds the acquisition price, or because of the pricing structure, the non-labor resources (accounting for about three-fourths of all farm inputs) do not support the asset fixity theory as an explanation of low farm returns over an extended period.

We must return to labor as the "problem" resource, if fixed resource theory is to provide an explanation of low farm resource returns. Labor is a durable resource; unlike other resources, it increases in supply—thanks to high birth rates—even though farmers do not purchase more from the nonfarm sector. Because a change in the labor input itself has little effect on farm output, it would appear that resource fixity would not explain excess capacity in agriculture. Labor is more important than its contribution to output might suggest, nevertheless, because capital inputs are often used in fixed proportions to labor on family farms and because labor is very important as a *denominator* in expressing returns per *unit* of labor.

In short, there are indications, cited earlier, that farm labor is in excess supply and that its marginal value product lies below not only its acquisition price but also its opportunity price less transfer cost P_T. This suggests that many farmers could increase their earnings by employing their labor resource elsewhere. Questions remain of whether earnings below P_T represent inefficiency and a cost to individuals and society and whether, in fact, the disequilibrium ascribed to fixity of labor even exists.

Whether earnings below P_T represent economic disequilibrium depends on the source of the gap. Given no disassociation of private and social costs (or returns), earnings of labor below P_T would indicate economic inefficiency, and the product of society could be raised by closing the gap. If the gap arises because of reasonable inertia in making adjustments to dynamic forces that constantly generate disequilibrium and the inertia can be overcome only with great trauma to workers, the gap may not represent a social cost. If the gap arises only because farmers, though fully informed of alternatives, place a high value on farming as a way of life, then the gap measured by usual economic yardsticks does not represent a social cost. If the gap arises only because farmers are uninformed of employment opportunities elsewhere or of the city way of life, it is then a social cost as well as a private cost unless the cost of providing such knowledge is prohibitive. And if the gap arises because of discrimination and labor unions that inhibit mobility, it may represent a private and social cost but no disequilibrium; that is, farm workers may not close the earnings gap because they cannot obtain the higher paying nonfarm jobs they are able to perform.

The flip-flop antithesis—the problem of high returns

I concluded that fixed resource theory explains the secular problem of low returns only through the labor resource, but even this last beachhead of alleged fixity is severely threatened. The challenge to the fixity of farm labor is raised by several findings: (a) that farm operator and hired laborer earnings are consistent with the schooling-earnings relationship over several occupations [16, p. 15]; (b) that rates of adjustment to equilibrium for farm labor and other resources are comparatively rapid [19]; and most important, (c) that farmers, according to the Hathaway-Perkins study [5], engage in considerable experimentation—a considerable number actually try nonfarm jobs, but 9 persons return to farming for each 10 who leave, presumably because it is the "best" alternative for use of resources.

The tentative conclusion is that there is no problem of low resource returns in farming, with factor markets operating efficiently to hold farm labor earnings to opportunity cost levels. Of course, there is dynamic resource disequilibrium, which is alleviated quickly enough by outmigration to keep farm earnings nearly on a par with nonfarm earnings. If farm resource earnings appear low, it is only because economists have imputed to farm labor too high an opportunity cost. And what was considered to be the major economic problem of commercial farms, low resource returns, evaporates—its only 'reality" an illusion created by economists. Fixed resource theory, then, helps to explain the lack of annual variation in farm input in the face of fluctuating prices but does not explain the "nonexistent" secular low returns on farm resources.

Acceptance of the antithesis places farm problems in an entirely new perspective. The problem becomes one of low absolute returns rather than low relative returns on farm labor. Raising the opportunity price of farm labor through education and training takes even greater priority. The problem of disequilibrium remains, but it is the high return on schooling investment (much of it financed from nonfarm sources) rather than the low return on farm production resources that becomes the singular focus of attention. Shortage of schooling, rather than excess of production resources, gains prominence. The new interpretation, emphasizing shortage and high returns rather than excess and low relative returns, is indeed a flip-flop.

Nevertheless, additional strong evidence contradicts the conclusion that resource markets are efficient. That ". . . back-movement into agriculture offsets 90 percent of the mobility out of the industry" [5, p. 351] reflects a serious lack of job information indeed and indicates that factor markets must be working very inefficiently. Only a small proportion of farm workers move to a nonfarm job each year, and there is no reason to suppose that even these are efficient in locating the best jobs available to them.

In addition, support for the proposition that much redundant labor remains in agriculture can be found from numerous sources in addition to those cited earlier. Ninety percent of all farm output is produced on farms that account for half of farm labor man-hour requirements. Since about 7 percent of farm production capacity is excess [17, 18], release of farm labor from units that produce one-tenth of farm output would cause no food and fiber shortage.[5] If this half of all farm labor has a marginal product greater than zero in the nonfarm sector, it could contribute more to society there. The conclusion that about half of farm labor is redundant is consistent with the production function results presented earlier. It is also supported by microeconomic results aggregated to area levels [27]. Finally, doubts have been raised about the validity for mobility studies of the Social Security data on which the "efficient-labor market" contention rests heavily [1].

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[5] In fact, output could expand as better managers would take over the smaller farms. In all likelihood, the marginal product of the above farm workers is negative, allowing for reorganization of farms.

I reject the flip-flop antithesis as premature. This should not be interpreted as belittling the massive and monumental accomplishment of factor markets—nearly 40 million net migrants have left farming since 1929! What is at issue is whether considerable redundant labor still remains in farming and whether factor markets need to be improved. My answer to both questions is "yes". It is not within the scope of this paper to list needed improvements in factor markets, but greater investment in education is certainly complementary with such improvements.

The thesis and antithesis can partially be reconciled. The farm labor market works most efficiently for the young, and outmigration of this group has enabled agriculture to dissipate much of the dynamic disequilibrium generated each year by output-increasing technology, inflation, and other factors. For the reasons discussed, operator labor and associated family labor do not so readily adjust out of agriculture, and it is this group that constitutes a sizable reservoir of surplus labor that in so many cases could be employed more profitably elsewhere.

The problem of surplus farm labor will diminish in the future, and the flip-flop antithesis will gain considerable validity. The pressures are now great to force excess labor from farms; these pressures come from high land and other capital costs, large know-how requirements, and other barriers to entry. Also, the farm population is becoming such a small portion of the national population that a sizable percentage can take nonfarm jobs without turning the economy upside down. In fact, a simple linear projection of farm worker numbers indicates no workers in farming by the mid-1980's. This of course is an unrealistic projection, but it does mean that rapid progress is being made in reducing the number of workers and that the absolute number of out-migrants will be able to slow considerably in the future. Signs of a slowdown were apparent in 1967 and 1968.

Increasing Returns to Farm Size

Numerous studies have documented the existence of decreasing average costs and increasing returns to size of farm firms [10]. But the concept has not been related to farm problems. The term "size" rather than "scale" is used. Returns to scale refer to the impact on farm output of a given change in the level of all resources in fixed proportion. Expansion of the farming units does not entail an equal percentage expansion in all resources, and the pure concept of returns to scale is academic, with little relevance to farm policy. The expansion in the farm firm is generally characterized by increasing the proportion of capital to labor and of variable capital to fixed capital. These changes result in a sizable reduction in cost per unit of production.

Evidence of decreasing costs per unit (increasing returns to size) is readily apparent in Figure 2 and Table 1.[6] The cost of all inputs (including the opportunity cost of equity capital and of operator and family labor) per unit of output (including receipts from farm commodities, nonmoney income, and government payments) averaged $2.67 on Class VI farms and $0.91 on Class I farms. Most of the economies of size appear to be achieved by Class II farms, and unit costs decline very slowly beyond an annual output of $30,000 per farm.[7]

The marginal and average revenue curves are indicated by the horizontal dotted line at $1 in Figure 2. The intersection of the revenue curve with the unit cost curve means that farms with sales under $25,000 on the average lost money and did not cover all production costs in 1960. Farms with sales over $25,000 received an economic rent per unit of output equal to the difference between the cost and revenue curves.

It may be said that small farms earned low returns because they paid too much for their land. Land tends to be a complementary input with farm size. There is constant pressure to expand farm acreage to achieve the economies of size so apparent in Figure 2. The savings through

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[6] Figure 2 is called a "unit" cost curve because it lies somewhere between the concepts of a long-run "average" and "marginal" cost curve. The curve is an average within an economic class of farm but is a marginal curve among classes.

The output-input ratio is defined as gross income from farming divided by the cost of all farm inputs, including the opportunity cost of equity capital and all labor. The labor cost is man-hour requirements in farming multiplied by the central city wage rate adjusted for age, education, and sex. In 1960, the median age of all farm operators was 51 years and median education was 7.8 years. For operators of Class VI farms, median age was 54 years and education was 7.0 years; hence, their parity labor income was reduced accordingly. The opportunity cost for farm operator labor was set at $2.20 per man-hour of farm employment on Class I, II, and III farms; $1.94 per hour on Class IV farms; $1.86 per hour on Class V farms; and $1.80 per hour on Class VI farms. Each man-hour of unpaid family labor was set at $1.60 per hour and each man-hour of hired labor at $1.54 per hour. These estimates are closely in line with 1959 estimates used on a USDA study [25, p. 17]. The average factory wage was $2.61 per hour in 1960 [22, p. 46].

[7] A cutoff of government payments could radically alter the economies of size curve depicted in Figure 2. By letting the parity ratio drop to 74 percent of parity in 1960 (1910–14 = 100) and giving a direct payment (grant) equal to the difference between a horizontal line through I and the unit cost curve multiplied by the units of output, a government program would cause farms to have constant returns to size. All resources would be paid their opportunity cost. Flattening the unit cost curve would cost the U.S. Treasury $10 billion and would remove much of the pressure to consolidate units. Problems of administering such a program would be overwhelming.

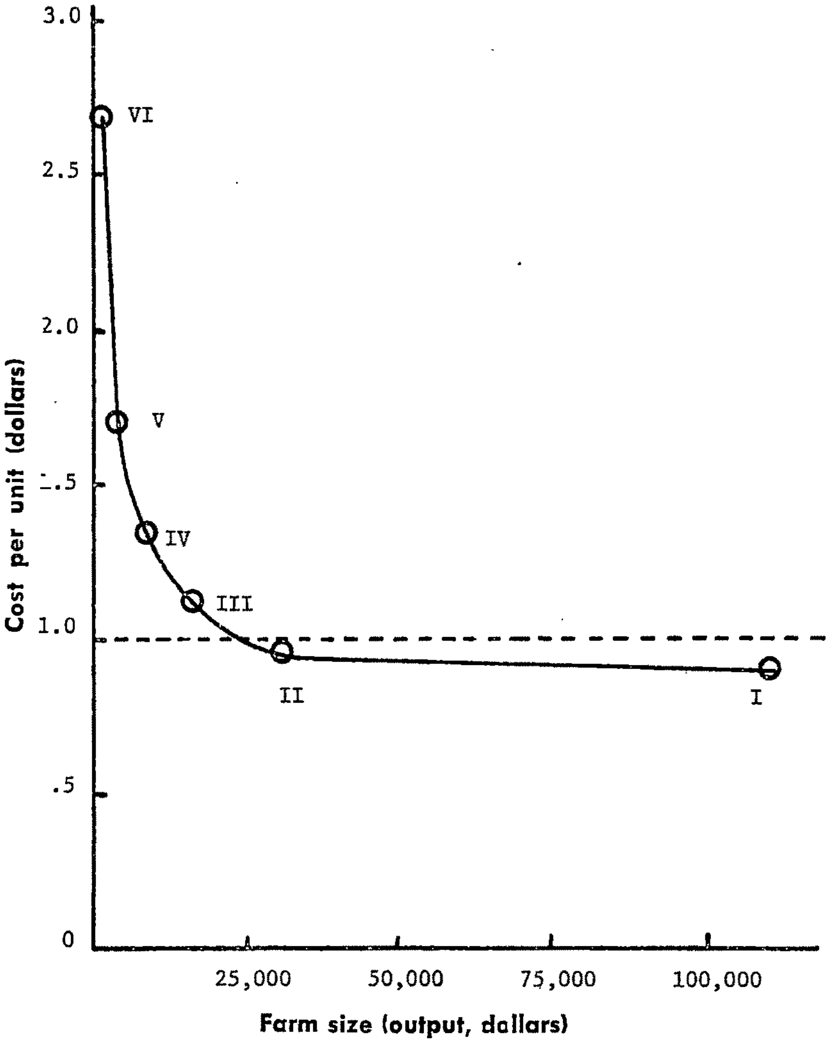

Figure 2. Long-run unit cost of farm production, by economic class of farms in 1960 (Source: Table 1)

greater efficiency are bid into the price of land. The actual price of land tends to be that price which will make all costs, including real estate interest, equal to the value of all farm receipts *on an economic size unit.*

Competition in the land market tends to bid the land price to the point where the return on land will be equal to the return on capital in other uses. A potential buyer who is unwilling to pay this price will find land bid away from him by the investor who wishes to maximize returns. And investors will not pay more than this price because a greater return

Table 1. Output, input, and efficiency by economic class of farms

	Economic class of commercial farms						Noncommercial farms
	I	II	III	IV	V	VI	
1960 input per output (unit cost, dollars)[a]	.91	.95	1.10	1.34	1.69	2.67	2.91
1960 output per input (efficiency, dollars)	1.10	1.05	.91	.74	.59	.37	.34
1960 output if all farm resources would have been used with respective farm-class efficiency (billion dollars)	46.9	44.9	38.8	31.8	25.4	16.0	14.7
Percent of all inputs in respective class of farms:[b]							
1960 (percent)	24.8	15.5	20.6	16.4	10.0	3.5	9.2
1965 (percent)	33.5	19.1	18.6	11.3	6.2	3.9	7.4

Sources [15, 22, 25].

[a] The input-output ratio was computed as follows: costs of land, capital, and labor were totaled and divided by all farm receipts (excluding off-farm income and including receipts from farm products consumed on the farm). In all cases the cost of nonreal estate durable capital was 5 percent interest plus depreciation. The cost of all farm labor was man-hour requirements multiplied by the wage rate of urban wage earners corrected for the age, education, and sex ratio of all farm hired, operator, and family workers.

[b] The 1960 and 1965 estimates are not strictly comparable. The farm dwelling interest charge and 60 percent of the auto interest and depreciation are excluded in 1960 estimates of production inputs but are included in the 1965 estimates because data were inadequate to remove them. Since dwelling and auto inputs tend to be relatively large for small farms, this at least partially explains the incongruously larger percent of inputs on the small Class VI farms in 1965 than in 1960.

can be achieved on nonland investments. The residual return to land tends to be greatest on large farms.[8] The law of one price [13] and the large potential number of investors will ensure that the "high" price for land on large, efficient farms will be the market price of land applicable to all farms.

The small farmer must pay this price or land will be bid away from him by an investor who has or can achieve an economic size unit. Thus, the small farmer tends to actually incur losses if he paid the current land price. And the small farmer who has full equity is losing money if a charge is made for the opportunity cost of his owned land valued at the current price of farm real estate. The tendency in some localities to bid up the price of farmland for potential nonfarm uses also contributes to *apparent* persistent low returns on resources assumed to be used only for farming.

Table 1 and Figure 2 suggest that land was not overpriced at the margin because large farmers were earning returns greater than needed to hold capital in farming. But land was clearly overpriced for an average farmer who had gross sales under $25,000.

The struggle to obtain an economic unit leads to further problems, apparent in Table 1. Output per unit of input is the reciprocal of the long-run cost curve in Figure 2 and essentially is the aggregate production function for farming units. Output per input is 1.10 on Class I farms and is only .37 on Class VI farms. The actual total volume of inputs was $42.8

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[8] This conclusion holds only on the average. Analysis of data for individual farms by Angus MacDonald of the Farmers Union shows that much variation exists among large farms in net income and resource returns.

billion and the average output per input over all farms was .85 in 1960. Had all inputs been used on farms of Class I efficiency, total output would have been $46.9 billion at 1960 prices.

Class I farms require a substantial input of feed and livestock provided by other farms. Their atypical structure means that if all farms were organized in this manner there would not be sufficient intermediate farm inputs. Class II farms are somewhat more typical and provide a more meaningful measure of the potential gain in efficiency obtainable by a more nearly optimum farm size and combination of inputs. If all farms were organized as Class II farms, the actual 1960 total input would have produced an output of $44.9 billion, or 24 percent above the actual level. If all farms had been organized as those in Class II, only 1.2 million farms could have produced the 1960 output with $34.5 billion of inputs—19 percent less inputs than the actual total 1960 inputs of $42.8 billion. Even discounting the shortcomings of the approach, the results clearly point to large potential efficiency from reorganization of farms into more nearly economic units.

And because most size economies were achieved by Class II farms in 1960, there would have been few economic advantages in having a system of superfarms that would have reduced the number of farms much below 1.2 million. This conclusion applies only to 1960 conditions. In the future the unit cost curve will move to the right, decreasing the number of farms compatible with maximum production efficiency.

The heterogeneous size structure of farms helps to explain why farm land is overpriced for most farmers and why returns are low on farm resources of most farmers. It also is a partial explanation of why farm product prices tend to be low. The continued trend toward larger farms, apparent in the 1960 and 1965 distribution of inputs in Table 1, increases farm output. Based on the distribution for these two years and the output-input ratio by class of farm in 1960, output would increase 6 percent, or 1.2 percent annually from 1960 to 1965, due to the change in size distribution with the same total volume of farm resources as in 1960. Other things equal, this depresses the revenue line in Figure 2 as supply presses demand and creates new pressures for farms to expand in size.

The decreasing cost theory is especially instructive in pointing out the permanency of the problem of low returns. An increase in the product price results in a larger residual return to land. The higher land return causes land prices to rise to the point where farm and nonfarm investors can realize a "parity" return on their investment. This land price is determined at the margin for adequate size units. It follows that small farms, which constitute a large majority of all farms, will receive a low return on all resources when valued at their imputed opportunity costs even with higher farm product prices. The majority of commercial farmers will be underpaid for their resources, whatever the parity ratio, as long as the distribution of farms and the cost curve remain similar to the pattern discussed above.[9]

Imperfect Competition and Low Returns in Farm Resources

Econometric studies show that the farm-nonfarm wage ratio is completely overshadowed by the national unemployment rate in explaining the net outmigration of farm labor [7, Ch. 9]. One conclusion is that there has been a persistent earnings differential attracting farm workers to nonfarm jobs. But employment of farm workers in nonfarm jobs is inhibited by discrimination, union hiring, and other elements of imperfect competition. Minimum wage laws also cause a departure from a market orientation and undoubtedly have inhibited the ability of many farm workers to find nonfarm jobs.

The markets in which farmers purchase inputs and sell commodities are generally characterized by some form of imperfect competition. The actions of a single firm can influence industry price. On the other hand, farming is generally classified as an atomistic industry; the actions of any one farm firm have no perceptible influence on prices in the farming industry.

Substantial research has focused on the market structure, conduct, and performance of firms selling inputs to farmers and marketing farm products [11, 12]. There is considerable evidence from these studies that input supply and marketing firms stabilize price by gearing output to effective demand. The firms, however, are reasonably efficient and in general do not earn profits out of line with other nonfarm industries.

Firms that purchase farm products frequently have a bargaining advantage over farmers, and they can be expected to pay no more than necessary for raw materials. But presence of monopoly elements in marketing firms that process and sell farm produced commodities would not explain low returns to farm resources. It is true that fewer farm resources would be employed than if the marketing sector were atomistic. But if farm resources were mobile, resource returns would equal opportunity costs.

In some instances, farm products may be purchased under monopsony conditions at prices below what the products would bring if sales were made to an atomistic marketing industry. There may be a single processor in a community. But again, this does not lead to low returns if farm resources are mobile. In some instances a monopsonist firm may pay high product prices to bring specialized resources into use, then reduce prices and depend on fixity of the specialized resources to maintain production. Then returns will not cover all production costs if resources are valued at acquisition prices. This latter problem has received little attention in research.

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[9] This conclusion must be qualified by possible changes in farm structure with a new type of government program or none. The cost curve in Figure 2, constructed for government programs of 1960, would change its shape under other types of programs—by how much is difficult to say.

The labor market is the major potential source of low returns on farm resources through imperfect competition. It can be shown theoretically that monopoly elements, in the form of labor unions selling labor in the nonfarm sector, create a tendency for excess labor and low relative returns on labor in the atomistic farming sector. The extent to which imperfect competition in the nonfarm labor market inhibits farm labor mobility and results in low farm labor earnings has received little attention in research. Another less serious source of possible low farm labor earnings is monopsony buying of labor, say, by a single major firm in an isolated labor market. This could be a large firm or a nonfarm firm hiring farm women and part-time farm operators.

Summary and Conclusions

The three theories advanced to explain persistent low returns in agriculture help to gauge the permanency of farm problems. The resource fixity theory implies that low returns would disappear if the rate at which output-increasing technology is released to farmers would slow, or if demand would increase sufficiently fast in relation to supply so that all farm resources would be valued at their acquisition cost. By this measure, the farm problem is somewhat "temporary."

The decreasing cost theory takes into account the size structure of farms and the valuation of real estate at the margin. Because the slack between returns and nonland costs tends to be absorbed by the land price, it follows that land prices will adjust to make returns equal resource costs at the margin on the efficient size units. As land values adjust, economic size farms will tend to receive an equilibrium (opportunity cost) rate of return on resources within a considerable range of prices received by farmers. It follows that whether product prices are high or low, roughly 90 percent of all farms will receive low returns when the opportunity cost of all resources is taken into account. This points to low returns even on most commercial farms over a long period until farms reach the "flat" portion of the unit cost curve. Farm bargaining power and government income-support programs only temporarily change the picture in Figure 2—these programs raise both total cost and total revenue so that the unit cost and revenue curves remain somewhat stable as the benefits become capitalized into the control instruments.

The third theory, imperfect competition, depicts the farm problem of low returns as virtually permanent, given racial discrimination and the economic structure of resource and product markets. Some forms of imperfect competition lead to relatively low earnings on farm labor, even if all the forces tending toward economic equilibrium work their full effect. Only a change in the structure of markets will alter the result as long as agriculture acts as a residual claimant of the labor force that cannot be used by the nonfarm sector.

The decreasing cost theory of farm problems is related to technology, imperfect competition, and fixed resources. The ability to expand farm size is linked to the ability of farmers to purchase more land. And the ability to buy land and consolidate farms is linked to the rate at which a neighbor can find employment outside of agriculture. The process of adjustment to economic farming units is slowed if operators of inefficient units are unaware of better alternative uses for their resources, if education is inadequate to equip farm people for the exodus, if low income farmers prefer farming as a way of life, and if labor unions and high national unemployment inhibit mobility. Technology, reflected in farm machinery and farm management, has given the shape to the unit cost curve in Figure 2 and is continually changing the shape. In contrast to Cochrane's treadmill theory, the decreasing cost theory does not depend on an inelastic demand and output-increasing technology to explain low resource returns. It derives its substance from labor-saving technology, economies of buying and selling in larger quantities, and labor and machine indivisibilities that give rise to economies of size.

In 1960, only about 10 percent of all farms were in the somewhat flat portion of the cost curve above $25,000 annual output. Public policy must be concerned with getting more of the remaining 90 percent of farms into that category. An unanswered question is how sensitive is the shape of the unit cost curve in Figure 2 and the distribution of farms along the curve to changes in the number of workers in farming. A preliminary conclusion, based on work with 1960 and 1965 data, is that the shape is not highly sensitive to outmovement of workers. Outmovement per se places more farms on the flat portion of the curve, but this tendency is offset to a considerable extent by a shift of the unit cost curve to the right. These problems of low returns on resources are likely to plague agriculture for some time, although workers are moving from agriculture at a rapid rate.

The decreasing cost theory shows how adequate size farming units can be profitable while the farm economy is generally depressed. These profitable firms can be the "mouth" to feed new inputs to an industry that is already oversatiated and can lead to problems of resource fixity.

Because the various theories explaining the persistence of low returns are highly interrelated, and for lack of empirical data on each, it is difficult to pinpoint the portion of the problem of low returns that can be imputed to each causal factor.

Finally, the antithesis of the persistency theories set forth in this paper is that virtually no disequilibrium in the form of low resource returns exists in agriculture. Labor markets function efficiently and quickly to eliminate both earnings disparities and, hence, dynamic disequilibrium, which is continually generated and quickly dissipated. The result is no latent excess labor, measured by low resource returns. If there appear to be measured low resource returns, it is only because those who are doing the measuring assign too high an opportunity cost to farm labor. While some evidence supports this antithesis, the majority of evidence contradicts it. The prematurity of this antithesis suggests that efforts be continued to improve the efficiency of factor markets. If the antithesis is true, then the one major economic problem of commercial operators in a growing farm economy is price and income instability. Even if problems of low average returns are overcome, some form of supply control may be necessary to stabilize farm prices.

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Shadow Prices as Member Returns for a Marketing Cooperative*

IAN W. HARDIE

Many marketing cooperatives handle several types or grades of member-supplied products. These cooperatives have to determine the returns to be alloted to each product. Helmberger, Hoos, and Nicholls have solved this problem for a cooperative with a single homogeneous product. However, their models do not extend readily to the multiple product case. This article describes how returns can be simultaneously calculated for each member-supplied product handled by a multiple product marketing cooperative. A linear programming model is first introduced to compute the returns under a set of rather restrictive assumptions. When these assumptions are relaxed, another method of deriving the values is required. Such a method—called the "pooling constraint" method—is presented in the latter part of the article.

IN 1941, Nicholls developed a theory for a marketing cooperative based on a derived demand and factor supply analysis [16]. His theory gave an answer to two of the fundamental questions about marketing cooperatives, namely, "What return should a member receive?" and "How well will the cooperative perform in the market?" However, Nicholls' supply-demand approach was not generally accepted until 1962, when Helmberger and Hoos used it to answer the same two questions in one of the most successful characterizations of a marketing cooperative to date [12, 9].

Helmberger and Hoos were limited by the derived demand construct to the case of a single homogeneous member-supplied product. But many marketing cooperatives receive several different member products and even single product cooperatives receive various grades of raw product with different profit potentials. A model based on homogeneous member products should therefore allow for different types and grades of raw material.

The purpose of this article is to replace the single product derived demand construct with a multiproduct construct based on a linear programming model. For any given quantities of member products, the shadow prices of the multiproduct model will be comparable to the member returns of the Helmberger-Hoos model. However, the two models will not be completely comparable because of the absence of heterogeneity in the one product case and because of the disparate production assumptions underlying the models. These points will be made more clear in the next section where the

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Helmberger-Hoos model is collated with a linear programming model containing a single type of constraint. After that the special linear programming model is extended into a multiproduct model made up of many types of linear constraints. But the more general model loses the properties of the special model and can no longer be collated with Helmberger-Hoos model. Consequently, a method is needed to recapture these properties and such a method is introduced in the final section.

Market performance of the multiple product marketing cooperative is not discussed in this article, as it deals only with the derivation of member returns.

Introduction to the Multiple Product Model

Four propositions underlie the demand-supply approach to the marketing cooperative:

(1) A marketing cooperative consists of a set of member firms bound by contract to market their output through jointly-owned facilities operated by a professional management staff.

(2) Management tries to maximize returns to the member-supplied product. The members receive these returns, and management determines each member's share.

(3) The division of returns should meet two criteria: Each unit of homogeneous product should receive the same return, and all of the net proceeds should be assigned to the members.

(4) The interaction between the member firms and the jointly-held organization is enough like a market transaction to be characterized by a demand-supply analysis.

Helmberger and Hoos constructed the following argument founded on these propositions. If the cooperative were interested in profit maximization, its profit function would be:

$$\pi = \overline{P}_y Y - \sum_{i=1}^{n} \overline{P}_i X_i - P_m M - F \tag{1}$$

where

π = profit,
Y = quantity of output produced by the cooperative,
X_i = quantity used of the ith productive factor,
M = quantity used of the member-supplied material,
F = total costs of fixed plant,
P_m = price of M,
$\overline{P}_i$ = fixed price of X_i, and
$\overline{P}_y$ = fixed price of Y.

But the cooperative is a nonprofit concern. Consequently, π should be set equal to zero. If, in addition, M is replaced by $\overline{M}$, that is, if the amount of member product available for processing is assumed to be fixed, "cooperative surplus" can be defined to be:

$$S = P_m\overline{M} \tag{2}$$
$$= \overline{P}_y Y - \sum_{i=1}^{m} \overline{P}_i X_i - F.$$

Maximization of the member returns gained from the given member product is equivalent to maximization of the cooperative surplus.

To maximize S, first minimize total variable costs:

$$C = \sum_{i=1}^{m} \overline{P}_i X_i \tag{3}$$

subject to the production function:

$$Y = Y(X_1, X_2, \cdots, X_n \mid \overline{M}, Z) \tag{4}$$

where Z represents fixed plant. This gives total variable cost as a single valued function of output:

$$C = C(Y). \tag{5}$$

Upon substitution into the cooperative surplus expression,

$$S = \overline{P}_y Y - C(Y) - F, \tag{6}$$

the surplus can be maximized with regard to output.

Let Y_0 represent the output that maximizes S, and let ATC_0 be the corresponding average total cost of production. Then, the maximum cooperative surplus is:

$$S = (\overline{P}_y - ATC_0) Y_0 \tag{7}$$

and the maximum net return accruing[1] to each unit of member product is:

$$P_{m0} = (\overline{P}_y - ATC_0) Y_0 / \overline{M}. \tag{8}$$

Parametric variation of $\overline{M}$ in equation (2) would yield a (short-run) member returns schedule. Further, when M is set equal to $\overline{M}$ in the profit function (1) and profit is maximized, P_{m0} is the average revenue product of $\overline{M}$. Thus, maximization of the joint operation's profit will also yield the member return, and parametric variation of $\overline{M}$ in the profit function will yield the member returns schedule.

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[1] The members are not likely to immediately receive all of P_{m0}. Part of the member return may be retained in a revolving fund to provide working capital for the cooperative. How much to retain, how long to retain it, what effect these retainings have on member supplies, etc. are important questions that are left unanswered in this article. Incorporation of these decisions into a cooperative model will not be easy, but further work in this area will be vital to a good understanding of a marketing cooperative. See Knutson [13, pp. 114–117].

On the strength of these findings, the proposed multiproduct model uses maximum profit for an objective. It also treats the member products parametrically. However, the multiple product model breaks with the production assumptions of the single product model; the production function of the cooperative's joint plant is assumed to be linear and homogeneous with discontinuous factor substitution so that the model can be put into a linear programming framework [1, pp. 23–31].

One of the motivating reasons for using linear programming is the Helmberger-Hoos treatment of the raw material as a limitational input. With its lack of a market price and fixed total available quantity, a limitational input is the type of input handled explicitly by a linear programming model [1, pp. 16–23]. The other motivating reasons are sixfold. The parametric variation of $\overline{M}$ in the Helmberger-Hoos model has an analogue in the parametric linear programming procedure. Linear programming models are among the most simple multiple product models. They are widely used in applied studies, are well explained in the literature, and are easily solved by the Simplex Method. Furthermore, they can handle large numbers of variables and equations, an important attribute when working with a large complex marketing cooperative.

Two other suppositions will help introduce the proposed model. The average variable cost of producing and selling each cooperative's finished products is assumed to be known and constant. All fixed costs are presumed to be allocable among the final products.[3] With these assumptions, the model of the joint operations of the marketing cooperative can be expressed as:

$$\begin{aligned} &\text{Maximize:} && q_0 = R_1'Q_1 \\ (9)\qquad &\text{Subject to:} && A_{11}Q_1 = X_1 \\ &&& Q_1 \geq 0 \end{aligned}$$

where

$Q_1 \equiv [q_j]$, an nth order column vector.

For the purposes of this section, the (variable) q_j represent either quantities of finished products or quantities of unused member products.

$R_1 \equiv [r_j]$, a $n \times 1$ vector.

r_j is interpreted for the present to be the net revenue gained from a unit of the jth finished product. $r_j = p_j - c_j$, where p_j is the (fixed) price and c_j is the (fixed) average total cost of finished product j.

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[2] The problem of allocating the overhead is difficult and is not solved by the multiple product model. All that is accomplished by the model is to let the overhead be allocated among the finished products instead of the member products—a division that is more likely to be in line with the accounts of the cooperative.

A r_j associated with an unused member product is assumed to be zero.

$X_1 \equiv [x_i]$, of order $m \times 1$.

x_i, until redefined, is the quantity of a raw product supplied to the cooperative by members.

$A_{11} \equiv [a_{ij}]$, a matrix of order $m \times n$.

a_{ij} is a fixed input-output coefficient and is interpreted as the amount of x_i associated with a unit of q_j. The column of a_{ij}'s corresponding to a particular q_j is called an "activity."

Assume there is at least one set of nonnegative values for Q that satisfies the constraints of model (9), and let the constraints be linearly independent. Then the fundamental theorem of linear programming guarantees the existence of an optimum solution with at least $n-m$ zero-valued variables. Model (9) can be rearranged to separate these $n-m$ zero-valued or "nonbasic" variables from the other "basic" variables. When this division is made, the basic variables will be renamed:

$Y \equiv [y_k]$ is the mth order column vector of basic variables. The basis—that set of input-output coefficients associated with the basic variables—shall be represented by the matrix B of order m, where

$$B \equiv [a_{ij}^*] \equiv [b_{ij}]$$

and a_{ij}^* is a coefficient of y_k. Elements from the inverse basis matrix will have superscripted indices.

Let Y be an optimum solution of the model (9). Then

$$Y = B^{-1}X_1, \tag{10}$$

and y_0, the maximum value of q_0, is

$$y_0 = V'Y \tag{11}$$

where

$V \equiv [v_j^*]$, an $m \times 1$ vector of the r_j (net revenues) associated with the basic variables.

The optimum solution of the dual problem of model (9) would be

$$\Pi = V'B^{-1} \tag{12}$$

where

$\Pi = [\pi_{11}]$, an $m \times 1$ vector of shadow prices associated with the x_i (raw materials).

Since

$$\Pi'X_1 = V'B^{-1}X_1 = V'Y = y_0, \tag{13}$$

all of the joint organization's profit is assigned to the members. Moreover, solve for any of the shadow prices, e.g., the first:

$$\begin{aligned}\pi_1 &= (y_0 - \sum_{i=2}^{m} \pi_i x_i)/x_1 \\ &= (\sum_{k=1}^{m} (p_k - c_k)y_k - \sum_{i=2}^{m} \pi_i x_i)/x_1\end{aligned} \tag{14}$$

and the similarity becomes evident between the shadow prices and the member return (p_{m0}) of the Helmberger-Hoos model. $\pi_1 x_1$ is total cooperative surplus minus the surplus assigned to the other member products.

The member return of the single raw product model incorporates the three criteria given earlier; namely, maximum cooperative surplus, equal payments for homogeneous products, and allocation of all earnings to members. The shadow prices meet these three criteria but they also introduce a fourth: a criterion for the division of total profit among the heterogeneous classes of member products.

Total profit is divided on an opportunity cost basis, since the raw products are not given market prices. When the raw materials are assigned an opportunity cost equal to their shadow prices, the net revenue from any unit of manufactured output is equal to the cost of utilizing the raw materials in its manufacture. Thus, the shadow prices equate marginal revenues with marginal "full" costs (costs including shadow prices) and average revenues with average full costs. The new criterion emerges from the equality of the averages: Each member receives the cooperative surplus earned by his products.[3]

The shadow price equations show how the multiproduct model introduces this fourth criterion. Since

$$y_k = \sum_{i=1}^{m} b^{ki} x_i, \tag{15}$$

$b^{ki}x_i$ is the contribution of raw product i to finished product k, the b^{ki} weights being determined simultaneously from the input-output coefficients of the optimum basis. When this contribution is multiplied by v_k, it becomes a monetary value; and when these monetary contributions are summed over all of the finished products, a shadow price emerges:

$$\sum_{k=1}^{m} v_k b^{ki} x_i = \pi_i x_i. \tag{16}$$

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[3] Division of the total cooperative surplus among the various member products is part of the "pooling problem" of a marketing cooperative. Most agricultural products can not be classified into completely homogeneous categories or pools. Consequently, the number of pools to be used becomes an economic question in which the cost of more pools must be balanced against the differing profit potentials of the materials within each pool. Sosnick [17] shows how to combine fine subclassifications of member products into pools, once the return accruing to each subclassification is known. The multiproduct model shows how to determine the return accruing to each pool of raw products, once the pools are known. Both approaches partly solve the pooling problem and, if combined successively, may be a way to completely answer it.

total cooperative surplus minus the surplus alloted to the other member products.

The reason why these two criteria are violated can be illustrated by the following example. Suppose one of the final products does have a downward-sloping demand curve and that this is partly accounted for by using the first of the aforesaid alternatives. Thus, a constraint is added to limit the output of this product, say to the quantity x_{m+1}. Any constraint that is binding will (most likely) have an associated shadow price that is positive.[8] Let π_{m+1} be the (positive) shadow price of the added constraint. Then equation (13) would become:[9]

$$\Pi^{o\prime}X_1 + \pi_{m+1}x_{m+1} = y_0^{\circ} \tag{17}$$

and the returns allocated to the raw products would be less than the total profit. Similarly, equation (14) would become:

$$\pi_1^0 = \left[\sum_{k=1}^{m} (p_k - c_k)y_k^0 - \sum_{i=2}^{m} \pi_i^0 x_i - \pi_{m+1}x_{m+1} \right] / x_1. \tag{18}$$

π_{m+1} is the increase in profit which could be obtained if an additional unit of the finished product could be sold at the price entered in the model. But this "cost" of not facing a perfectly elastic demand should not influence the distribution of realizable profits to the members and, as equation (18) shows, it does.

The "pooling constraint" method modifies the augmented model in order to remove the effect of shadow prices like π_{m+1}. Before this method is described, however, model (9) needs to be converted into an augmented model. To do this, let $\mu > m$ and $\eta > n$ and let:

$$X \equiv \begin{bmatrix} X_1 \\ X_2 \end{bmatrix},$$

X_1 is the mth order vector of member-supplied products defined in model (9). X_2 has $\mu - m$ elements and is a vector of "other limitational inputs."

$$Q \equiv \begin{bmatrix} Q_1 \\ Q_2 \end{bmatrix},$$

Q_1 was defined earlier. Q_2 is the $(\eta - n)$th order vector of variables which are added to the original multiproduct model.

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[8] This ignores the situation where a constraint is binding and the shadow price is zero. In such a case, the augmented model's solution would meet the criteria of model (9).

[9] The augmented model would have a different set of shadow prices for the member products; hence, Π is replaced by $\Pi^o = [\pi_i^o]$. Also, the production plan and profit would be different; therefore y_0 is replaced by y_0^o and y_k by y_k^o. y_k is also replaced by y_k^o in equation (18).

$$R \equiv \begin{bmatrix} R_1 \\ R_2 \end{bmatrix},$$

R_2 contains the coefficients of the objective equation associated with Q_2.

$$A \equiv \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix},$$

A is a $\mu \times \eta$ matrix of input-output coefficients. The partitions are between the mth and the $(m+1)$th rows and the nth and the $(n+1)$th columns. The augmented model is:

$$\text{(19)} \qquad \begin{aligned} \text{Maximize: } & R'Q \\ \text{Subject to: } & AQ = X \\ & Q \geq 0. \end{aligned}$$

A "hat" will be used to denote "optimum and basic" for the augmented model. Thus:

$\hat{B}(\equiv [\hat{b}_{ik}]\ i, k = 1, \cdots, \mu)$ is the optimum basis of the augmented model.
$\hat{Y}(\equiv [\hat{y}_k]\ k = 1, \cdots, \mu)$ is the vector of the augmented model's optimum basic variables.
$\hat{V}(\equiv [\hat{v}_k]\ k = 1, \cdots, \mu)$ is the vector of basic r_j's.

The shadow prices of model (19) will be represented by:

$$\hat{\Pi} = \begin{bmatrix} \hat{\Pi}_1 \\ \hat{\Pi}_2 \end{bmatrix},$$

$\hat{\Pi}_1$ is the vector of member product shadow prices. $\hat{\Pi}_2$ contains the shadow prices of the other limitational inputs.

The Pooling Constraint Method

Equation (13) embodied two of the four criteria of the original multiproduct model. It indicated that all of the cooperative surplus is to be returned to the members and that each member is to receive the surplus added by his products. For the augmented model, the equation corresponding to (13) is:

$$\text{(20)} \qquad \hat{\Pi}_1{}'X_1 + \hat{\Pi}_2{}'X_2 = \hat{V}'\hat{Y} = \hat{y}_0.$$

However, this equation does not embody the two criteria unless $\hat{\Pi}_2{}'X_2$ happens to be zero.

A zero value for $\hat{\Pi}_2{}'X_2$ is unlikely if the added constraints effectively restrict the augmented model's solution. Thus, the two criteria are not likely to hold. Suppose, though, that the augmented model is reformulated so that X_2 is replaced by a null vector. Then the inner product of $\hat{\Pi}_2$ and X_2 will always be zero and the criteria will be recaptured. This is the basic approach of the pooling constraint method.

The method requires the addition of a variable and a constraint to the augmented model. The resulting model, called the "pooling model" is:

Maximize: $R'Q$

$$\text{Subject to: } \begin{bmatrix} \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} & \begin{bmatrix} 0 \\ -X_2 \end{bmatrix} \\ [D_1'] & [D_2] \end{bmatrix} \begin{bmatrix} \begin{bmatrix} Q_1 \\ Q_2 \end{bmatrix} \\ q_{\eta+1} \end{bmatrix} = \begin{bmatrix} \begin{bmatrix} X_1 \\ 0 \end{bmatrix} \\ 0 \end{bmatrix} \tag{21}$$

and to

$$Q,\ q_{\eta+1} \geq 0.$$

where

$D_1 \equiv [d_j]$ $j = 1, \cdots, \eta$.

$E \equiv [d_j^*]$ is a $\mu \times 1$ vector of the d_j coefficients associated with basic variables of the augmented model.

$D_2 \equiv -E'\hat{Y}$.

$q_{\eta+1}$ is called the "pooling variable" and the last constraint is called the "pooling constraint." The pooling model assumes that the augmented model has already been solved. Otherwise, D_2 will not be known. It also assumes the pooling constraint is linearly independent of the other constraints.

The augmented model and the pooling model will have the same optimum primal solution if the pooling variable is equal to one. To verify this, consider the following argument. If $q_{\eta+1} = 1$, the only difference between the two models is the pooling constraint. The addition of a constraint can never better a model's optimum solution. Moreover, the optimum solution found for the augmented model satisfies the pooling constraint. Consequently, this solution must also be an optimum solution for the pooling model.

The pooling variable will equal one if the optimum basic variables of the augmented model are the other basic variables of the pooling model. To demonstrate this, $q_{\eta+1}$ needs to be incorporated into the optimum basis of the augmented model. Let $\overline{B}$ denote the expanded optimum basis formed by adding the coefficients associated with the pooling constraint and pooling variable:

$$\overline{B} = \begin{bmatrix} \hat{B} & \tilde{X}_2 \\ E' & D_2 \end{bmatrix} \tag{22}$$

where

$$\tilde{X}_2 = \begin{bmatrix} 0 \\ -X_2 \end{bmatrix}.$$

The expanded basis can be inverted by the partitioned inverse method [6]:

$$\overline{B}^{-1} = 1/d\begin{bmatrix} \hat{B}^{-1} + \hat{B}^{-1}\tilde{X}_2E'\hat{B}^{-1} & -\hat{B}^{-1}\tilde{X}_2 \\ -E'\hat{B}^{-1} & 1 \end{bmatrix} \tag{23}$$

d is the determinant of $\overline{B}^{-1}$ and

$$\begin{aligned} d &= D_2 - E'\hat{B}^{-1}\tilde{X}_2 \\ &= -E'\hat{B}^{-1}X - E'\hat{B}^{-1}\tilde{X}_2 \\ &= -E'\hat{B}^{-1}\tilde{X}_1 \end{aligned} \tag{24}$$

where

$$\tilde{X}_1 = \begin{bmatrix} X_1 \\ 0 \end{bmatrix}.$$

The primal solution of the pooling model associated with this basis will be:

$$\overline{Y} = \overline{B}^{-1}\overline{X} \tag{25}$$

where

$$\overline{Y} \equiv \begin{bmatrix} Y \\ y_{\mu+1} \end{bmatrix}$$

$$y_{\mu+1} = q_{\eta+1}$$

$$\overline{X} \equiv \begin{bmatrix} \tilde{X}_1 \\ 0 \end{bmatrix}.$$

When $y_{\mu+1}$ is picked out of the primal solution:

$$y_{\mu+1} = \begin{bmatrix} \dfrac{-E'\hat{B}^{-1}}{-E'\hat{B}^{-1}\tilde{X}_1} & \dfrac{1}{-E\hat{B}^{-1}\tilde{X}_1} \end{bmatrix} \begin{bmatrix} \tilde{X}_1 \\ 0 \end{bmatrix} = 1, \tag{26}$$

it is easy to see that the pooling variable equals one when the $\hat{y}_k$ are the other basic variables of the pooling model.

The solution to the pooling model can be found by using the Simplex Method of solving a linear programming problem. Four steps are required:

(1) Solve the augmented model by the Simplex Method.
(2) Delete all nonbasic variables from the optimum solution of the augmented model.
(3) Calculate D_2 and form the pooling model by adding the pooling constraint and pooling variable.
(4) Solve the pooling model by the Simplex Method.

The primal solution of the pooling model is the primal solution of the augmented model plus the pooling variable. But the pooling model's dual solution will generate shadow prices for the member products that totally exhaust profit:

$$\hat{y}_0 = \bar{\Pi}'\bar{X} = \bar{\Pi}_1'X_1 \tag{27}$$

where

$\bar{\Pi}$ is the $\mu+1$ vector of the pooling model's shadow prices.

$\bar{\Pi}_1$ is the column vector of the first m components of $\bar{\Pi}$.

The first m shadow prices can be extracted from the dual solution of the pooling model and interpreted. Since

$$\begin{aligned} \bar{\Pi}' &= [\hat{V}' \quad 0]\bar{B}^{-1} \\ &= 1/d[\hat{V}'\hat{B}^{-1} + \hat{V}'\hat{B}^{-1}\bar{X}_2E'\hat{B}^{-1},\ -\hat{V}'\hat{B}^{-1}\bar{X}_2] \\ &= 1/d[\hat{\Pi}' + \hat{\Pi}'\bar{X}_2E'\hat{B}^{-1},\ \hat{\Pi}'\bar{X}_2], \end{aligned} \tag{28}$$

the shadow prices of the raw products will be:

$$\bar{\Pi}_1' = \hat{\Pi}_1 + (E'B_1/E'B_1X_1)\hat{\Pi}_2'X_2 \tag{29}$$

where

B_1 ($\equiv[\hat{b}^{ih}]$ $i=1, \ldots, \mu$, $h=1, \ldots, m.$) is the first m columns of $\hat{B}^{-1}$.

Recall that $\hat{\Pi}_1$, $\hat{\Pi}_2$, X_1, and X_2 are all from the augmented model and that $\hat{\Pi}_2'X_2$ is the total profit assigned the limitational "inputs" that were *not* member products. Thus, the new member product shadow prices are made up of $\hat{\Pi}_1$—the member product shadow prices of the augmented model—plus a proportion of $\hat{\Pi}_2'X_2$.

The proportions are obviously influenced by E. The vector E and D_1 could come from any linearly independent pooling constraint. However, only one pooling constraint will meet the fourth criterion of the original multiproduct model. This is the constraint where

$$D'_1 = [1, \cdots, 1]. \tag{30}$$

Let D_1 and E be vectors of ones. Then:

$$E'B_1 = \left[\sum_{k=1}^{\mu} \hat{b}^{k1},\ \sum_{k=1}^{\mu} \hat{b}^{k2},\ \cdots,\ \sum_{k=1}^{\mu} \hat{b}^{km} \right], \tag{31}$$

that is, $E'B_1$ is the column sums of the first m columns of $\hat{B}^{-1}$. Next, recall that

$$\hat{y}_k = \sum_{i=1}^{\mu} \hat{b}^{ki}x_i$$

and that the weights in the weighted sum of inputs making up $\hat{y}_k$ are the linearly transformed input-output coefficients of the optimum basis. Since the first m of the inputs are the member products, the numerators of the proportions are the contributions of a unit of member product h to all μ of the optimum basic variables. Similarly, the denominator is the contribution of all of the member products to all of the $\hat{y}_k$.

The shadow prices assigned to X_2 are pooled into a single value and then redistributed to the members according to the proportionate contribution of each member product. Thus, a total monetary value and proportions replace the sum of monetary contributions making up the shadow prices of the original model (see equation (16)). But both models use the contribution of the member product to the optimum basic variables to distribute the cooperative's surplus. Consequently, both return to each member what his products add to the cooperative surplus.

The choice of D_1 as a vector of ones plays a critical role in the pooling constraint method. D_1—and hence, E—could be multiplied by any scalar without affecting the pooling model's primal or dual solution. But if the d_j components chosen for D_1 are not all equal to the same numbers, some of the raw product returns will be enhanced at the expense of the others. In such a case, the relative values assigned to the raw products would not be completely determined by the linearly transformed input-output coefficients, and the fourth criterion of the original multiproduct model would not hold.

The cooperative's management might prefer a set of unequal coefficients if the resulting returns would encourage the members to supply a more salable mix of raw products. On the other hand, some of the members might feel that such coefficients create inequitable member returns.

The pooling constraint method can be applied for any D_1, unless the pooling constraint turns out to be linearly dependent. When this happens, $E'B_1X_1$ is zero, and the second term of equation (29) is undefined. There is no simple way to tell when $E'B_1X_1$ will equal zero, but if it does, the coefficients of the pooling constraint would have to be redefined before the pooling constraint method could be used.[10]

One alternative specification for D_1 would be to assign to a variable representing a finished product a coefficient of one and to specify a coefficient of zero for the other variables. Then the proportions of equation (29) would include only the contribution of the raw products to the finished products and not their contribution to all of the variables. This alternative is less desirable because it arbitrarily removes some of the effects of the member products on the total cooperative surplus. Nevertheless, it may solve the problem of a linearly dependent pooling constraint.

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[10] If no desirable alternative to the chosen A_{21} exists, the components of A_{21} could be perturbed slightly. (See [2, Ch. 10] for an example of a perturbation procedure.) Perturbing the components is a poor option, however, for the proportions of equation (27) are highly sensitive to the choice of perturbed coefficients.

The pooling constraint method might be applied to a convex programming problem. Hartley and Hocking use a linear model to approximate the nonlinear problem in their method of solving convex programming models [10]. This linear programming model can be converted into a pooling model. Should the economic meaning of the pooling model turn out to be reasonable, the assumption of fixed production coefficients and discontinuous factor substitution would no longer be necessary. The convex model might provide a good foundation for a study of the market performance of a multiproduct marketing cooperative.

Summary and Conclusion

This article has been concerned with the question: "What returns should a member receive from a multiple product marketing cooperative?" Multiple raw products were emphasized because the single member product case had already been worked out by Helmberger, Hoos, and Nicholls. The article:

(1) Summarized the Helmberger-Hoos single product model.
(2) Introduced a special multiproduct model formulated as a linear program.
(3) Compared the special model with the Helmberger-Hoos construct.
(4) Extended the special multiproduct model into an augmented model which is more amenable to empirical application, but which lost two of the desirable properties of the special model.
(5) Developed the pooling constraint method to recapture these properties.

Three criteria for the member returns underlie the Helmberger-Hoos model. They are: (1) maximize the total cooperative surplus (i.e., the total amount to be returned to the members), (2) return all of the cooperative surplus to the members, and (3) allocate the same return to every unit of a homogeneous member product. The multiproduct model introduced different types and grades of raw products and so needed an additional criterion: (4) pay each member product what it contributes to the cooperative surplus.

Formulating the multiple product model as a linear program is attractive from the viewpoint of isolating the fourth criterion. It also is useful when doing an empirical study [8]. Although longer run conclusions about the cooperative's market performance can not be readily drawn for the linear model, as they can be for the Helmberger-Hoos and Nicholls models, the linear programming approach presented in this article may be a start toward a theory of a multiple product marketing cooperative.

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A Conceptual Framework for Analyzing Economies of Vertical Integration*

SAMUEL H. LOGAN

The objective of this paper is to develop a framework for quantitatively analyzing economic aspects of vertical integration by a firm. The model is based on a firm that possesses a multidimensional or lexicographic utility function in which some optimizing criteria are established for several variables. The two particular firm goals considered in this case are maximization of return on investment and reduction of short-run risk. The effects of integration are considered first in terms of changes in costs under conditions of certainty and then in terms of changes in costs and/or uncertainty under imperfect market coordination. The latter situation occurs when the market mechanism is inadequate with respect to communicating the necessary or correct requirements of price and product specification.

VERTICAL coordination of production, processing, and marketing activities has been of concern to agricultural economists, businessmen, and government policy makers for some time. The continued growth of large, integrated operations has increased the importance of this subject area, yet most of the published research in this field has been descriptive in nature or has been limited to one phase of the economics of integration e.g., cost reduction. The net result has been a continuing void in the availability of guide lines for analyzing the economic aspects of vertical integration for either business executives or governmental administrators.

Studying economic aspects of vertical integration can be approached from two directions: (1) from the viewpoint of the firm that is initiating the integration, or (2) from the macro or industry level in terms of social costs and benefits. The former considers individual utility functions; the latter emphasizes the social welfare function.

In order to understand fully the social aspects of integration, we must first consider the consequences, if any, of vertical integration on efficiency of the firm's operation or on the entrepreneur's utility function. This paper concentrates on this first step by developing a framework for analyzing quantitatively the value of vertical integration at the firm level.[1]

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[1] For a discussion of vertical market structures at the industry level, see Baligh and Richartz [2].

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Integration Defined

Integration is part of the larger spectrum of coordination of the various levels of production and processing between the initial producer and the final consumer. The definition followed in this paper is one offered by Mighell and Jones [19]—that integration is the combination of two or more levels of activity into one firm. Thus integration is the extension of a firm's administrative decisions into areas of market coordination typically allocated to the free market mechanism.

Integration and Firm Growth

The basic foundation for studying vertical integration can be found in the literature on firm growth theory typified by Penrose [21], Halter [13], Coase [6], Farrar [10], and Baumol [3]. The development of firm growth theory has underscored the inadequacy of profit-maximization as the sole objective of the firm and hence as a tool for explaining and predicting behavior of firms. Certainly, decision criteria of a nonprofit nature play an important, if not the major role, in the development of vertically integrated operations. While vertical integration may not alter total sales significantly (if the output of one stage is consumed internally by another stage), it may affect both the profits and risk facing the firm, variables which may rank high on a particular firm's utility function.

When several objectives help determine the firm's course of action, the firm possesses a utility function with multiple dimensions. Thus, a firm may try to maximize its rate of growth, subject to constraints on risk, rate of return on investment, sales, or profits. The general utility function, for example, might take the form:

$$U = f(Z_1, Z_2, Z_3)$$

where

U = utility of the firm,
Z_1 = rate of return on investment,
Z_2 = sales, and
Z_3 = some measure of risk.

Lexicographic utility functions

Maximization of multidimensional utility functions can be accomplished when these goals can be ordered lexicographically [11, 9, 8, 17]. Such lexicographic orderings establish priorities for achieving the separate goals. Thus, the first goal (e.g., a certain level of net income) must be met before the second goal (e.g., a higher share of industry volume) becomes of dominant importance. In this manner, the firm can possess several objectives, but because of the lexicographic preferences, there is a basis for orderly decision making if two or more goals are in conflict.

One of the major properties of lexicographic utility functions, as outlined by Encamación [9] and Ferguson [11], is the constancy of utility from Z_1 after it reaches the "satisfactory" level Z_1^*. This assumption forces an indifference map, such as that in Figure 1, and may be unrealistic, since utility in either section of the utility surface is changed by altering only one of the variables regardless of what happens to the other.

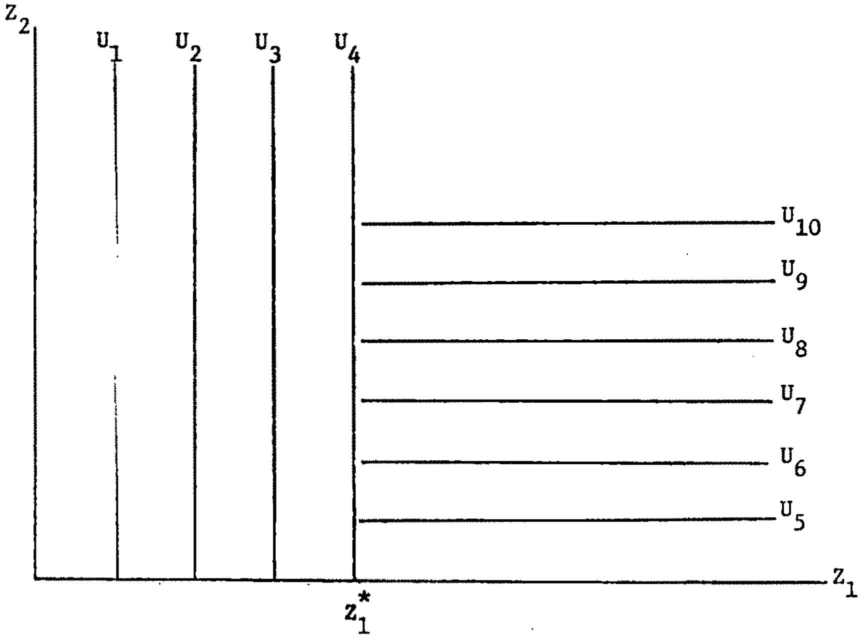

Figure 1. **Lexicographic indifference surface for Z_1, Z_2 without substitution between Z_1 and Z_2**

Although the indifference surface may be discontinuous where $Z_1 = Z_1^*$, it would seem more reasonable to allow some substitution beyond that point (Figure 2). While either assumption is arbitrary, permitting some substitution of Z_1 for Z_2 after the satisfactory level for Z_1 has been reached would seem to be the more general case, although it does not provide as concise a framework for maximizing utility.

Return and risk as utility variables

The model to be developed below is based on two major goals: (1) risk reduction and (2) growth in some quantitative measure of achievement,

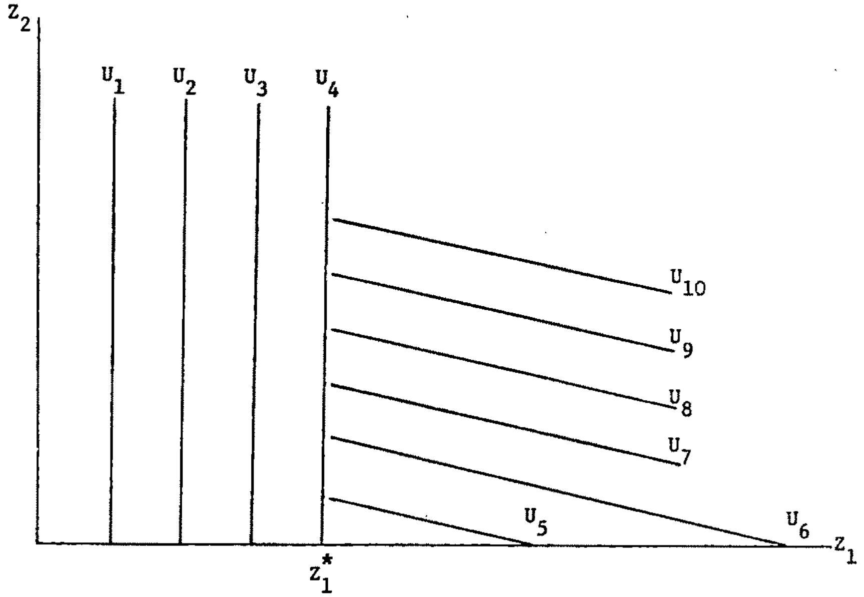

Figure 2. **Lexicographic indifference surface for Z_1, Z_{2*} with substitution between Z_1 and Z_2 for $Z_1 \geq Z_1^*$**

return on investment in this case.[2] Using certainty equivalence techniques [17, 10], we can consider the firm's general utility function as:

$$g = f(V, E(r))$$

where

g = utility,
$E(r)$ = the expected return on investment, and
V = the variance of the return on investment, i.e., the risk factor.

If the firm's policy is to hold risk (V) within some boundary level, k, or if the ratio of variance to expected value must be less than or equal to some level, h, then the firm's utility function has lexicographic ordering with two components.[3] In the latter case, illustrated in Figure 3, the general form of the lexicographic utility function is:

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[2] Return on investment is an arbitrary measure of financial success. We could just as reasonably have included profits, sales, growth in assets, etc. To this extent the reader should not consider return on investment as a limiting assumption.

[3] Baumol, [2] proposes selection of investments on the basis of $E(r) - K\sqrt{V}$ where K is a constant. This criterion equates the degree of risk to be considered with each investment since the probability that the return will fall below $E(r) - K\sqrt{V}$ is the same for a given K. Baumol's criterion eliminates some of the decision problems found in Markowitz's procedure and could be used in the above format rather than the $V/E(r)$ ratio.

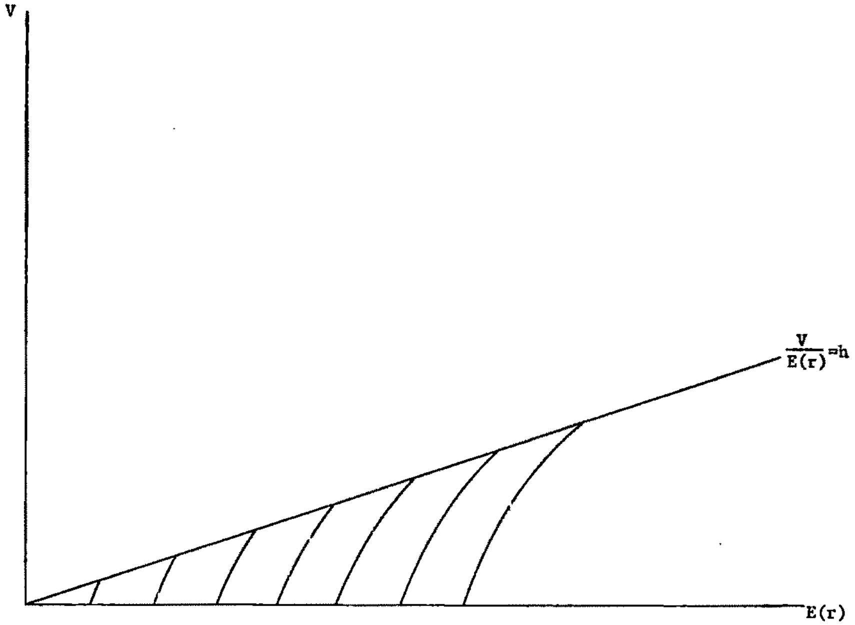

Figure 3. **Indifference curves showing points of equal utility between V and $E(r)$ with a constraint that $V/E(r) \leq h$**

$$U = f(Z_1, Z_2)$$

where

Z_1 = ratio of variance (risk) to expected return on investment and
Z_2 = expected return on investment.

The first constraining condition is that Z_1 must be less than $Z_1^* = h$. Thus, all investment alternatives falling to the left of the ratio constraint line, $V/E(r) = h$, are infeasible to the firm. In the feasible area, some substitution between V and $E(r)$ has been included, indicating that a lower risk investment is preferred to a higher risk venture, given the same expected return on the investment.

Multiple Time Periods

Decisions on long-term investments (including integration) must consider the cash flows or returns generated over time by the investment. These flows, in turn, can be used to estimate the rate of return on investment or the present value of the stream of cash flows (Spencer and Siegelman [25]) for purposes of comparing investment alternatives.

A complete model of firm growth by integration would include the multiple time periods; however, for the purposes of exposition, the developments that follow center on single time period analysis. The results can be generalized to include the time as a relevant variable.

Long-run investment risk differs somewhat from risk for short-run single periods. Long-run risk, for instance, might include changes in consumer preferences, technological obsolescence, etc., whereas the short-run risk might be more closely associated with price and supply fluctuations or quality control of inputs.

Let us consider, then, the components of the utility function that appear applicable in the case of vertical integration. Initially we shall restrict ourselves to the situation in which certainty prevails; then we shall turn to the more general case including short-run risk.

Certainty and the Rate of Return

The nature of the return on investment from integration depends on (1) whether the two levels of activity to be integrated are independent of one another (i.e., decisions at one level do not affect decisions at the other level) or (2) whether interdependencies exist between the two that can be exploited. Koopmans [15] has shown that, if activities are independent, decentralized decision making affords efficient allocation of resources. In this case, the expected return from integration results simply from the profits of the integrated operation itself; costs and revenues at all levels remain the same—the ownership merely has changed. When the levels are interdependent, better marketing opportunities and market control may increase joint revenues of production.[4] Similarly, the total joint costs for all levels of integrated activity may be reduced because of interdependent technological conditions.[5]

In the first case, the expected total return from the two integrated activities would be

$$E(r_1 + r_2) = E(r_1) + E(r_2).$$

Interdependency, however, may involve a change in the population by either increasing revenues or reducing costs. Assuming costs (revenues) are reduced (raised) by a constant amount k for the first activity, the expected total return is

$$E(r_1 + k + r_2) = k + E(r_1) + E(r_2).$$

The expected return to investment that may be attributable to integration, then, would become

$$E(r_1 + k + r_2 - r_1) = E(r_2 + k) = E(r_2) + k,$$

where the firm at level 1 is doing the integrating.

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[4] See, for example, the study by Taylor and Pasto [26] on vertical integration and multiple pricing in the maple syrup industry.

[5] Mueller and Collins [20].

Because much of the integration in agriculture is aimed at obtaining a supply of inputs, we shall focus our attention on cost reduction, although this formulation should be applicable to the other two areas also.

Intrafirm integration

At each level of activity in producing, processing, and marketing a commodity, the business operation is composed of several processes. Thus, we might divide firm operations into five basic categories: (1) procuring inputs, (2) financing both short- and long-run operations, (3) producing the product, (4) marketing the final good, and (5) managing the entire process. These functions must also be integrated into a harmonious combination at the firm level (French, Sammet, and Bressler [12], and Danø [7]).

Define the following cost functions:

(a) Finance

$$X_1 = f_1(q, k \mid h),$$

(b) Procurement

$$X_2 = f_2(q, v_1 \cdots v_n, X_1 \mid h),$$

(c) Production

$$X_3 = f_3(q, w_1 \cdots w_n, X_1, X_2 \mid h),$$

(d) Marketing

$$X_4 = f_4(q, r_1 \cdots r_n, X_3 \mid h), \quad \text{and}$$

(e) Management

$$X_5 = h + f_5(q).$$

where

X_1 = financial costs per unit,

X_2 = procurement costs per unit,

X_3 = production costs per unit,

X_4 = marketing costs per unit,

X_5 = management costs per unit,

q = quantity produced per unit of time,

k = exogenous market factors, e.g., prime interest rate,

w_i, r_i, v_i = variable factors of production, and

h = constant factor.

The last function with factor h reflects the fact that management may be constant or given over large intervals of q, but that some inherent features may exist that differentiate between management of large companies and those of smaller concerns. At any one level of activity in the market structure, these relationships must be integrated by any particular firm. Thus, we can define

$$Z_j = g(X_{1j} \cdots X_{5j})$$

as being the total cost function facing a firm at level j. This function, of course, is a function of several functions; and the optimum scale of operation, given the total function, may bear no resemblance to the scale which optimizes operations of the individual functions as illustrated by Danø [7].

In a nonintegrated industry with several levels of activity in the market structure, the total costs involved in getting the product from producer to consumer (assuming equal output capacities or ranges for all levels) may be represented by the summation of the individual firm functions at the various levels of activity, or

$$Z_t = \sum_j Z_j$$

where

$$Z_t = \text{the total function.}$$

Interfirm integration

When a firm can coordinate the above five categories among various levels of activity more effectively (or profitably) than the market mechanism, there will be an inducement to integrate vertically [4, 24]. Extension of administrative decision by one firm into a new level of activity may offer a superior (more profitable) organizational structure to regular market system, a factor that may arise not only from the administrative capabilities within the firm, but also from the imperfect nature of coordination from or the cost of using the market system [see 6, 22]. Similarly, integration by merger offers a firm one means of bypassing the limitations of current management's skills and knowledge in new areas cited by Penrose [21]. It may also offer a means of obtaining additional financing ability through use of assets of the firm that is integrated.

In such cases, the integration of the above five functions at different levels probably will not be the same as the summation of the total firm functions over different levels of activity. In this case we have

$$Z_t^* = f(X_1^*, X_2^*, X_3^*, X_4^*, X_5^*)$$

where the * superscript indicates an integrated function.

For a firm that utilizes the outputs of other levels of activity as inputs, the question is one of determining whether the change in costs for producing a given output plus the accumulation of profits accruing to other levels of activity offers sufficient return on the investment. Penrose [21, p. 146] notes that

> . . . the profitability of backward integration is measured by its effect on the net revenue of the firm. Hence the opportunity to increase profits by integrating backwards is to be treated in the same way as other productive opportunities of the firm—the additional profit expected must be compared with the expected profit from alternative uses of the resources required.

The above formulation is basically the same as that given graphically by Mighell and Jones [19] in a planning system for firms with vertical combinations.

Risk as a Decision Variable

Evaluating a firm's action solely in terms of maximizing return on investment is not always applicable, as noted earlier. Other restraints may outweigh the potential return of an investment. Penrose [21, p. 147] adds that

> . . . backward integration, like other forms of diversification, is promoted by a desire to avoid the risk of fluctuations and to enhance the security of the firm in the face of a generalized uncertainty. In this latter case, the statement that a reduction in cost is a condition of profitable backward integration is a purely formal one, for 'cost' is reduced only because of an arbitrary, noncalculable, and essentially psychological element attributed to the firm's attitude toward uncertainty.

Seaver [23, p. 1491] is even more emphatic with respect to the relative importance of risk aversion as a motive for integration. He says:

> Frankly, the core of the problem is not production costs, whether farm or plant. . . . There are two aspects of integration, neither of which has received sufficient attention from agricultural economists, that offer an opportunity to "hit the jackpot." The first of these deals with risk and uncertainty associated with the operation of the "free market"; the second with monopoly and market control.

Risk of a short-run nature frequently occurs in agricultural processing industries. Some components of this risk may be internal to the operations of the firm, while other aspects may result from the inadequacies of the market system coordination as presently organized [22]. In many cases, inputs are purchased on the basis of estimates (as in the case of livestock) concerning the quality and quantity with which the raw product will be converted into final product. These estimates are subject to considerable error and may be the source of operating losses to the company [18].

In other instances, risk manifests itself through extreme variations in the quantity of raw product available to producers at given times. This variation can affect processing costs if the firm utilizes large amounts of fixed factors [16]. Dependence on price competition is no guarantee to a processor that his supply will be increased [20].

Reduction in such short run risk either of the internal sort or of the market type can be a strong inducement for some firms to integrate, just as elimination of marketing risk through forward integration is a motivating factor to other firms. The effects of integration on total short-run risk faced by the firm can also alter the profit structure (and thus return on investment) of other levels of activity in the integrated firm, a factor that can be of prime importance in decision making about long-run growth of the firm.

Measuring risk

Many of these risk factors are difficult to define, let alone measure, and perhaps a firm may be able only to establish whether the risk under integration is just "more or less" than that in an open market. However, some risk factors often can be quantified. For example, statistical techniques can be applied to past price and supply trends, or to employee performance, in an attempt to estimate the risk factor under the various market structure alternatives.

If we can measure the risk associated with return on investment as the variance of that return or the variance of a major component of that return (e.g., costs or revenues that can serve as a proxy variable), then we can estimate the change in risk through use of integration. Define

σ_1^2 = variance of return on investment at level of activity 1 (r_1),

σ_2^2 = variance of return on investment at level of activity 2(r_2), and

r_{12} = correlation between r_1 and r_2;

then, combining the two operations,[6]

$$\sigma_{1+2}^2 = \sigma_1^2 + \sigma_2^2 + 2r_{12}\sigma_1\sigma_2$$

where the third term on the right is twice the covariance between r_1 and r_2.

If the two levels of activity are independent with respect to return on investment, the covariance is zero; and the variance of the combined levels is simply the sum of the individual variances. A negative correlation between r_1 and r_2 will result in a combined variance of less than the sum of the individual variances or in a reduction of risk. A positive correlation will mean the combined variance is larger than the sum of the component variances.

The *net* risk of investment in integration, then, would be given by

$$\sigma_{1+2}^2 - \sigma_1^2 = [\sigma_1^2 + \sigma_2^2 + 2r_{12}\sigma_1\sigma_2] - \sigma_1^2 = \sigma_2^2 + 2r_{12}\sigma_1\sigma_2.$$

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[6] For a discussion of variability in combined farm operations, see Carter and Dean [5].

Stochastic factors

When a firm faces a production function that includes uncertainty (or lack of ability for precise measurement of variables) for quality and/or quantity of output from a given set of inputs, we can define the function as:

$$Q_j = f(v_1 \cdots v_n, e_j)$$

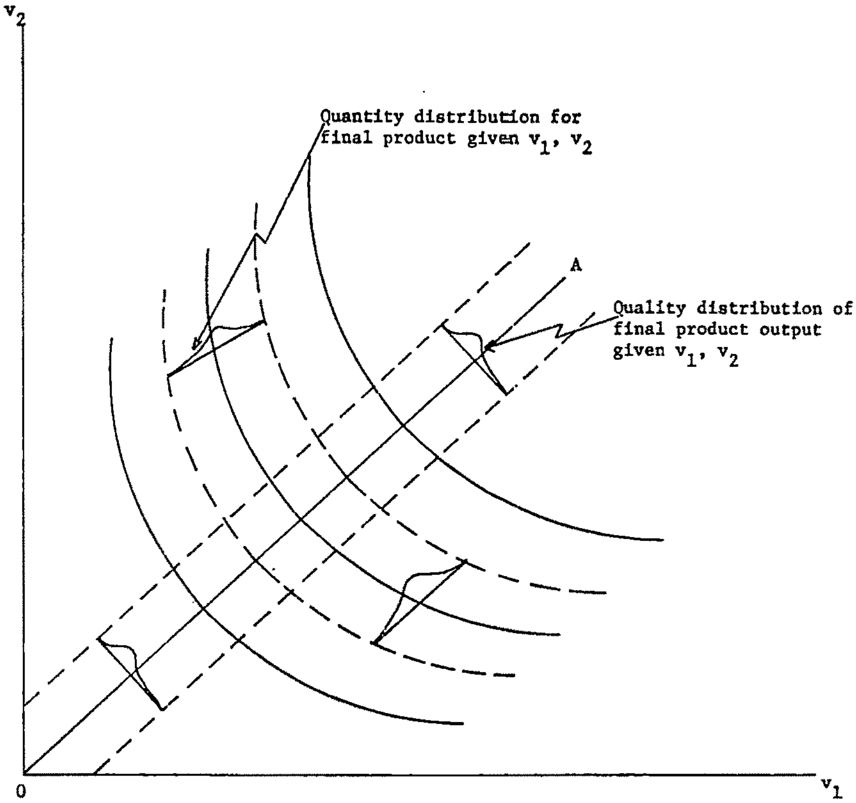
where

Q_j = output of firm at level j,

v_i = factors of production, and

e_j = a stochastic variable with mean and variance (μ, σ^2).

Graphically, this situation is illustrated in Figure 4. Assume the firm uses two inputs to produce one final product. The two inputs, v_1 and v_2, are dif-



v_2
Quantity distribution for final product given v_1, v_2
A
Quality distribution of final product output given v_1, v_2
0
v_1

Figure 4. Isoquants with quality and quantity risk factors for inputs v_1 and v_2

ferent quality forms of the same factor of production; however, in the raw product stage the quality aspect must be estimated either by observation or by sample techniques (such as good and choice grade slaughter cattle). The net result is that, for any combination of v_1 and v_2, the final product Q will not necessarily possess the same quality proportion as indicated by v_1/v_2. A particular ray from the origin, such as OA, indicates a set quality ratio of inputs [7], but the actual quality of final product will have a probability distribution around that ray.

Similarly, the quantity of output indicated by the usual isoquant form may not be totally dependent on v_1 and v_2 but may also have a probability distribution around the isoquant for any particular combination of v_1 and v_2 because of possible spoilage or rejections in the inputs or misestimation on the part of buyers.[7]

Of course, if the inputs can be evaluated with certainty, and the production process itself is not subject to random fluctuations in performance of workers, etc., then the traditional deterministic isoquants become applicable.

The above production relationships may be considered for two particular levels of activity, h and j:

$$Q_j = f(v_i, e_j) \quad \text{and}$$
$$Q_h = f(w_i, e_h)$$

where

w_i=factors of production used in level h.

By integrating backward, for instance, firm j may be faced with a combined production function indicated by:

$$Q_j^* = f(v_i, w_i, e_j^*).$$

If the only change in the functional relationship is in the error term, the advantage of integration at each level can be measured by comparing the means and variances of e_j and e_h with those parameters for the distribution of e_j^*.[8]

Similar risk factors may exist for the other phases of operations within a firm, e.g., finance, procurement, marketing, and management at all different levels of activity in the production-processing-marketing structure.

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[7] The quantity risk just outlined, however, is different in nature from the shifts in supply of raw products frequently cited as a reason for integration [20]. This latter factor relates to the nature of stability of the flow of raw products during all parts of a given time period, such as one year. Random divergences from such a pattern will, of course, alter the nature of average unit costs facing the firm for that time period, with the net effect that the average long-run cost curve shifts upward and may be distorted from the equilibrium position. Conceptually, the risk of stable supplies can be incorporated into the above framework.

[8] It is possible that the covariance between the two levels of activity will act so as to *apparently* reduce the variance of only one component level, but considering the variances of the components separately after integration can be misleading.

Depending on the nature of the firm's aversion to risk (utility function), a reduction in the variance of the error factor, even without a change in its mean, may be sufficient to warrant integration. By narrowing the distribution around its mean through integration, the firm may effectively cut its "probability" of going broke if severe fluctuations in any of the functional relationships can be fatal financially. This type of return cannot be put into a usual rate of return on investment figure.

However, depending upon the nature of the frequency distribution of the variable, changing the variance or risk may also alter the mean, a factor that in turn can affect the profit picture and thus return on investment. For such a change to be successful, the integration generally must be associated with a conscious management strategy in the use or coordination of the various levels of activity.

Price risk

If the risk that exists in the price function facing the firm is such that in a purely competitive market

$$P_j = K + e_j,$$

where K is a constant and e_j again is the stochastic term, then the profit function at any one level of activity may be considered

$$\begin{aligned}\pi_j &= P_jQ_j - TC_j \\ &= (K + e_j)f(v_i, e_j) - g(Q_j),\end{aligned}$$

where

$g(Q_j)$ = the total cost function for the firm.

For this particular level of activity, integration may not alter the price uncertainty; but the production function may be altered with a change in the error factor; and the cost function itself may change, thus giving a different profit function.

The change in profits for activity level j becomes part of the measure of return on the investment to level j from integration and must be included in the decision of whether to integrate along with the regular measures of return (cash flow) on investment.

Conclusions

Vertical integration, like most types of firm growth, is more complex with respect to underlying causes and effects than situations represented in the maximization of a single variable such as profits or return on investment. The use of lexicographic or multidimensional utility functions offers a more satisfactory method to analyze and explain firm integration. The model developed above postulates two variables in a firm's utility function that might logically apply to integration: (1) maximization of return on investment and (2) reduction in short-run risk. While each variable will assume different importance from firm to firm, risk reduction undoubtedly plays an important part in decisions to integrate.

Thus, a firm must consider more than just return on investment resulting from the profits of the new level to be integrated; it must also know the change in profits of its current operation after integration. In addition, the firm must analyze the risk associated with the quantity and quality of the supply of inputs (or outputs) before and after integration. Such risk may be focused on only parts of the total operation, such as the internal operation of the firm or the external market mechanism.

Decision making must consider jointly the change in the distribution of these risk factors after integration with the return on investment (or other utility variable).[9] And the two variables may not be independent themselves. Thus, for example, changing the nature of the distribution of return on investment may result in a change in the expected return, depending upon the type of distribution. These changes must also be associated with some specific management or administration plan or strategy in the use of the integrated components.

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An Analysis of Daily Fluctuations in the Hog Economy*

RAYMOND M. LEUTHOLD

A recursive model is developed to identify and evaluate the major factors affecting daily fluctuations in hog prices and quantities supplied. Using two years of data, packer price bids for slaughter hogs are found to depend upon lagged wholesale prices, present and lagged quantities of hogs marketed, and the day of the week. Producer's daily marketing responses depend upon lagged price, day of the week, and season of the year. Elasticity of supply is very high, ranging from 8 to 10. Daily ex post forecasts of price and quantity supplied are made for a one year period and indicate that variations in the regression coefficients from month to month, resulting from updating of the model, provide virtually no improvement of the forecasts over using an initial set of coefficients. The developed model predicts daily price fluctuations more accurately than a naive model tested.

PAST research on hog marketing has been confined largely to investigations of recurrent hog price cycles, trends, and patterns. Relatively few investigators have analyzed short-run, or daily, price variations. This research void may have stemmed from the difficulty in obtaining and handling daily time series data. High speed electronic computers now make it feasible to process and store the large amount of information needed for the analysis of daily data.

Much remains to be learned about the day-to-day hog market and its response to changes in various economic variables. More information about demand and supply functions is needed for improved policy formulation and decision making by market participants. The study reported in this article was designed to identify the major factors affecting daily price and quantity movements and to provide knowledge about the relevant economic behavioral relationships within hog marketing. A demand and supply model is formulated and estimated and future daily price and quantity fluctuations are predicted by using the results of the estimated model.

The price and quantity supplied patterns examined are based on data for the public terminal hog markets located in Chicago, Indianapolis, Kansas City, Omaha, South St. Joseph, East St. Louis, South St. Paul, and Sioux City, the eight largest hog markets in the United States. These markets represent the major concentration points of buyers and sellers and act as a guide in the pricing of hogs in other markets [8; 9, p. 11].

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Economic Model

Demand for live hogs

The quantity of live hogs demanded is a derived demand, as hogs are the major raw material in producing pork. Normally, using classical economic theory and assuming profit maximization, the quantity of an input demanded depends upon its price, the price of other inputs, and the price of the product [1, 5]. However, at the major hog markets the supply of hogs generally arrives before the markets open, and the markets are then cleared each day. The daily quantity demanded by the buyers on any particular day is predetermined by the quantity available, and price is the adjusting mechanism.[1] Therefore, the demand function expresses input price as a function of quantity, product price, plus other variables such as storage and day of the week.

In choosing the variable to represent the price of the product (wholesale pork cuts), it was recognized that when packers bid on live hogs during day t, they must have expectations of wholesale prices for days $t+5$ to $t+7$ (the time needed for processing and shipping the cuts). Their expectation models are probably relatively complex. For simplicity, I used the most recent wholesale price information, the previous day's price $(t-1)$, as a proxy variable to represent these expectations. As this price increases, packer price bids for slaughter hogs will likely increase the next day because of the expectation of higher wholesale prices in the future.

It was also hypothesized that the price packers offer for hogs depends in part upon the number of hogs they have on hand and the amount of pork in cold storage. Eleven models were tested, using various combinations of lagged terminal and interior market quantities [7] to find a proxy to represent these storage items.[2] Selecting the model that gave the largest coefficient of multiple determination, the most appropriate proxy was found to be the aggregate quantity supplied by the eight terminal markets for each of the previous two days. Thus, these two quantities were included in the demand function to represent storage under the assumption that, as these quantities increase, subsequent packer price bids will decrease, and conversely.

Additional factors cause the packers to vary their price bids on hogs according to the day of the week. One is the packers' attempt to fill a specific number of hours per week in their labor contract, requiring them to increase their price bids at the beginning of the week so that they can purchase large quantities of hogs and be assured of fulfilling the contracts and maintaining a uniform rate of slaughter throughout the week. This and other associated influences are represented by dummy variables that shift the demand function according to the day of the week.

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[1] Of course, quantity varies from day to day and from week to week. However, trading at the terminal hog markets is conducted in such a fashion that sellers have virtually no chance to respond to the price within the day. This trading characteristic is not necessarily true for country buyers, dealers, and auction markets, which are not analyzed in this study.

[2] Since daily data on cold storage and hogs on hand are not readily available, previous quantities supplied are used as approximations of storage.

Finally, as mentioned above, quantity delivered each day was included in the demand function as an exogenous variable. All variables are defined more specifically below.

Supply of slaughter hogs

The supply function for slaughter hogs in this study is derived from the classical equilibrium theory of the firm. Hog producers are assumed to operate in a purely competitive market and attempt to maximize profits. One shortcoming of the theory, however, is that it fails to distinguish between marketing (short-run) decisions and production (long-run) decisions. Since our concern is with the short run, the classical theory is modified somewhat to exclude past production costs and most other long-run influences.

The quantity of hogs supplied at the eight terminal markets arrives before the markets open and there is virtually no opportunity for producers to adjust their shipments in response to price within the day at these same markets. Therefore, it was assumed that producers operate on the basis of an expected price for their hogs, which is based on information generated prior to the marketing day. Eleven models, using various weighted and simple moving average schemes of past prices to represent this expectation, were tested. The model that produces the largest coefficient of multiple determination is one in which the expected price is the same as the previous market day's price, after adjusting for the day of the week [7]. Thus, price lagged one period was included as an explanatory variable in the supply function, with the expectation that as this price increases, producer marketing responses will increase the next day, and conversely.

Previous studies have shown the day of the week to be an important influence on quantity supplied [2, 10]. Farmers tend to market more hogs at the beginning of the week, especially Monday, because they expect higher prices then and they have more time on weekends to prepare their livestock for market. This phenomenon is represented by dummy variables, which shift the supply function according to the day of the week.

Hog farrowing follows seasonal patterns and this subsequently affects the number of hogs to be marketed at later times, after the necessary feeding period. A variable that shifts the supply function according to this seasonal adjustment was included as an explanatory variable.

The Statistical Model

The demand and supply functions, as specified above, define a recursive model of the cobweb type, where first the quantity supplied is determined through the supply function and then this quantity is sold in the market at a price determined through the demand function. That is, the quantity demanded is a predetermined variable and the error terms of the demand and supply functions are assumed to be independent. Thus, with the normal assumptions on stochastic regressors, ordinary least squares regression will yield consistent and asymptotically unbiased estimators of the parameters of each function [4, pp. 269–271, 279–280, 354–355; 6, pp. 75–77].

The double-log functional form was used for both the demand and supply functions based on the assumption that buyers and producers respond to percentage (or relative) changes in the market. Because of the interest in explaining daily changes rather than absolute amounts, plus the need to reduce autocorrelation in the residuals and multicollinearity in the original values, the economic data were transformed into first differences of logarithms.[3] However, the dummy variables were not transformed into first differences and were specified to act as shifters of the functions. The entire statistical model can be represented as follows:

$$\begin{aligned}\text{Demand: } \Delta \log P_t = {} & \beta_{11}\Delta \log Wh_{t-1} + \beta_{12}\Delta \log Q_t \\ & + \beta_{13}\Delta \log Q_{t-1} + \beta_{14}\Delta \log Q_{t-2} \\ & + \beta_{15} \log M + \beta_{16} \log T + \beta_{17} \log W \\ & + \beta_{18} \log F + u_{1(t)}\end{aligned}$$

$$\begin{aligned}\text{Supply: } \Delta \log Q_t = {} & \beta_{21}\Delta \log P_{t-1} + \beta_{22} \log M + \beta_{23} \log T \\ & + \beta_{24} \log W + \beta_{25} \log F + \beta_{26} \log S + u_{2(t)}\end{aligned}$$

where:

P_t = average price in dollars per hundredweight of all barrows and gilts sold at the eight markets[4] in day t;

P_{t-1} = representation for expected price by producers, defined the same as P_t but for the previous day;

Q_t = total number of head of barrows and gilts sold at the eight markets[5] in day t;

Q_{t-1}, Q_{t-2} = "proxy" representations for storage, defined the same as Q_t but indicating quantity on previous days;

Wh_{t-1} = representation of the price of the product, measured as a weighted average (based on a percent of total live animal weight) of the prices in dollars per hundredweight of major wholesale pork cuts, Chicago;

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[3] All logarithms are natural logarithms.

[4] The average price per hundredweight at any one market is the total cost of all barrows and gilts in a day, times one hundred, divided by the total weight of all the animals. The average price for the eight markets is a simple average of the separate market averages.

[5] The effect of weight on price cancelled out when the eight markets were aggregated.

$$M\begin{cases}=2.71828\ldots \text{ if Monday}\\ =1.0000 \text{ otherwise;}\end{cases}$$

$$T\begin{cases}=2.71828\ldots \text{ if Tuesday}\\ =1.0000 \text{ otherwise;}\end{cases}$$

$$W\begin{cases}=2.71828\ldots \text{ if Wednesday}\\ =1.0000 \text{ otherwise;}\end{cases}$$

$$F\begin{cases}=2.71828\ldots \text{ if Friday}\\ =1.0000 \text{ otherwise;}^{6}\end{cases}$$

$$S\begin{cases}=2.71828\ldots \text{ if March, April, August, September, October,}\\ \quad\text{November}\\ =1.0000 \text{ otherwise;}^{7}\end{cases}$$

t = time in days;

Δ represents first differences, such that $\Delta \log Q_t = \log Q_t - \log Q_{t-1}$, and $\Delta \log Q_{t-1} = \log Q_{t-1} - \log Q_{t-2}$, etc.

Procedure and Results

Two years of data, 1964 and 1965, or approximately 500 observations, were available for estimation.[8] In order to observe how the coefficients change over time, the demand and supply equations were estimated over 14 alternative time periods. The procedure in each estimation was to use a time series of 12 months, or about 250 observations, so that the coefficients could be compared over several time series of similar length. The equations were first estimated using the data for all of 1964; then, with data from February 1964 through January 1965, from March 1964 through February 1965, and so on. This pattern of dropping one month in 1964 and adding the next month in 1965, always maintaining a time series of 12 months, was followed to the last possible combination, using the data for all of 1965. Finally, the equations were estimated using the full two years of data, making a total of 14 combinations. These coefficients were then examined to determine how hog marketing and pricing patterns changed over time. The

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[6] Dummy variables cannot be specified for all five days of the week, as this creates a linear combination in the columns of the raw moment matrix and makes the matrix singular; so Thursday was chosen as a base. None of the eight markets is open on Saturday.

[7] The year was divided into two seasonal groups to reflect farrowing patterns. The six months listed represent those months in which quantity supplied is generally greater than in the previous month. In the other six months, quantity supplied is usually less than the previous month.

[8] The price and quantity data were obtained from records compiled by USDA Market News Reporters located at each of the eight markets.

data were added and dropped in monthly groups (rather than weekly or daily) so that the results could be conveniently reported in this article.

Demand function estimates

The results of the estimated demand equation are given in Table 1. In the first row of the table, the signs of the coefficients of the wholesale price and three quantity variables are consistent with expectations. These coefficients approximate percentage responses, so the first quantity coefficient implies that a one percent increase in the quantity of hogs in time t results in about a 0.05 percent decrease in the price of hogs in time t. Similarly, the two lagged quantity coefficients indicate that a one percent increase in quantity in time $t-1$ results in a 0.04 percent decrease in price in time t, while a one percent increase in quantity in time $t-2$ results in about a 0.02 percent decrease in price in time t. An alternative interpretation of these three coefficients is that a one percent increase in quantity in time t results in approximately a 0.05 percent decrease in price in time t, a 0.04 percent decrease in price in time $t+1$, and a 0.02 percent decrease in price in time $t+2$. These coefficients indicate that packers adjust their price bids not only to present day quantities, but also to quantities for the previous two days, which are a proxy for storage volume. The magnitudes of these coefficients are very small, but consistent with the data—quantity usually fluctuates from 50 to more than 100 percent daily, whereas price generally fluctuates only one to three percent daily.

The wholesale variable coefficient implies that a one percent increase in the wholesale price in time $t-1$ results approximately in a 0.35 percent increase in the price of hogs in time t. This finding indicates that changes in the wholesale market are important in explaining price changes in the live hog market, and the positive sign provides information on the relationship between wholesale prices one day and the resulting packer decisions concerning their live hog price bids the next day.

The dummy variables merely cause the demand function to shift according to the day of the week. Combining the coefficients with the constant term gives some indication of the relative size and direction of the price changes between days, other things equal. Monday has the largest average percentage price change relative to the average of all changes, and the positive sign indicates that price increases on Monday relative to the price the previous Friday. Prices generally also increase slightly on Tuesday, but they decrease the remainder of the week, the largest decrease occurring on Friday. These reactions by packers throughout the week are as expected; they make higher bids at the beginning of the week to assure themselves of enough hogs for slaughter to fulfill their labor contracts and then make lower bids at the end of the week so as to keep storage over the weekend to a minimum.

Table 1. Results of demand equation estimations using aggregated data; dependent variable: $\Delta \log P_t$

Time period	Independent variables[a]									R^2	d
	Constant term	$\Delta \log Wh_{t-1}$	$\Delta \log Q_t$	$\Delta \log Q_{t-1}$	$\Delta \log Q_{t-2}$	$\log M$	$\log T$	$\log W$	$\log F$		
January 1964–December 1964	−.0026*** (.0014)	.3536* (.0471)	−.0542* (.0035)	−.0417* (.0040)	−.0155* (.0036)	.1609* (.0218)	.0768* (.0242)	−.0199 (.0246)	−.0804* (.0196)	.5487	1.5990
February 1964–January 1965	−.0023*** (.0014)	.3664* (.0460)	−.0520* (.0035)	−.0407* (.0040)	−.0164* (.0035)	.1476* (.0218)	.0682* (.0243)	−.0123 (.0246)	−.0803* (.0195)	.5325	1.6604
March 1964–February 1965	−.0024*** (.0014)	.3627* (.0467)	−.0530* (.0035)	−.0418* (.0040)	−.0174* (.0035)	.1493* (.0215)	.0803* (.0242)	−.0076 (.0248)	−.0852* (.0199)	.5339	1.6175
April 1964–March 1965	−.0029** (.0014)	.3588* (.0465)	−.0505* (.0032)	−.0392* (.0036)	−.0165* (.0032)	.1529* (.0211)	.0834* (.0227)	−.0010 (.0234)	−.0684* (.0192)	.5465	1.6235
May 1964–April 1965	−.0025*** (.0014)	.3450* (.0445)	−.0503* (.0032)	−.0388* (.0036)	−.0162* (.0032)	.1522* (.0216)	.0845* (.0232)	−.0008 (.0239)	−.0732* (.0194)	.5494	1.6178
June 1964–May 1965	−.0018 (.0014)	.3565* (.0441)	−.0508* (.0032)	−.0393* (.0036)	−.0158* (.0032)	.1440* (.0215)	.0782* (.0230)	−.0004 (.0235)	−.0848* (.0192)	.5570	1.6154
July 1964–June 1965	−.0022 (.0013)	.4467* (.0471)	−.0493* (.0031)	−.0386* (.0035)	−.0156* (.0031)	.1369* (.0212)	.0780* (.0221)	.0088 (.0226)	−.0833* (.0191)	.5710	1.5733
August 1964–July 1965	−.0020 (.0013)	.4153* (.0475)	−.0474* (.0031)	−.0391* (.0034)	−.0154* (.0029)	.1227* (.0211)	.0890* (.0218)	.0172 (.0219)	−.0770* (.0192)	.5497	1.5307
September 1964–August 1965	−.0025** (.0013)	.4279* (.0510)	−.0455* (.0029)	−.0363* (.0033)	−.0141* (.0029)	.1191* (.0195)	.0898* (.0204)	.0277 (.0204)	−.0743* (.0178)	.5336	1.5896
October 1964 September 1965	−.0030** (.0013)	.4026* (.0536)	−.0441* (.0031)	−.0369* (.0034)	−.0142* (.0027)	.1194* (.0204)	.1084* (.0212)	.0335 (.0212)	−.0692* (.0187)	.4932	1.4500
November 1964–October 1965	−.0035* (.0013)	.3909* (.0520)	−.0444* (.0031)	−.0364* (.0034)	−.0134* (.0029)	.1373* (.0204)	.1202* (.0211)	.0381*** (.0211)	−.0662* (.0188)	.5044	1.4172
December 1964–November 1965	−.0035* (.0013)	.3748* (.0511)	−.0445* (.0030)	−.0366* (.0033)	−.0141* (.0028)	.1404* (.0206)	.1322* (.0210)	.0378*** (.0211)	−.0677* (.0185)	.5096	1.4219
January 1965–December 1965	−.0033** (.0014)	.4016* (.0547)	−.0481* (.0034)	−.0401* (.0037)	−.0167* (.0031)	.1466* (.0222)	.1389* (.0227)	.0500** (.0229)	−.0978* (.0209)	.4973	1.3874
January 1964–December 1965	−.0030* (.0010)	.3813* (.0363)	−.0506* (.0025)	−.0414* (.0027)	−.0169* (.0024)	.1509* (.0157)	.1806* (.0166)	.0195* (.0168)	−.0879* (.0145)	.4985	1.5156

[a] Standard errors are in parentheses.
* Significant at the 99 percent level.
** Significant at the 95 percent level.
*** Significant at the 90 percent level.

In the remainder of Table 1, the coefficients for all the variables, except Wednesday, maintain their respective signs throughout all 14 estimations. However, there is no discernible pattern of variation in the magnitudes of the coefficients over time, as some get larger in absolute size while others get smaller. The importance of this variation in coefficients over time will be more easily judged later when price predictions are made.

The coefficient of multiple determination for the demand function ranges from a low of .4932 to a high of .5710, with the two extremes resulting from estimations that have nine months of data in common. These coefficients are rather low, not an unusual outcome when using first differences [3]. Also, some variables undoubtedly have an influence in short-run time periods but are not measurable on a daily basis.

Because of the large sample size of each estimation, the Durbin-Watson (*d*) statistic can only approximate a test for the presence of autocorrelation of the residuals. Using the computed statistic of 100 observations as a guideline, any *d* statistic below 1.50 would probably indicate that positive autocorrelation is present. This outcome occurs in four of the 14 estimations.

Supply function estimates

The supply function results, estimated for the same 14 time periods described previously, are given in Table 2. In the first row of the table, the coefficient for lagged price is 8.2771, which is of expected sign. This price elasticity is rather high, but is in keeping with the size of the daily fluctuations and is consistent with Stover's [11] elasticity estimates for daily prices, published in 1932, which range from 4.4 to 12.0. Presumably, hog producers are very responsive to the previous day's price change in determining the quantity of hogs to be marketed, suggesting a potentially volatile market.

Coefficients of the dummy variables for days of the week indicate that, on the average, quantity supplied increases on Monday relative to the previous Friday and then generally declines the remainder of the week. This is as expected when considering the results of earlier studies [2, 10] and packer pricing habits throughout the week. The positive sign of the coefficient for the season dummy variable is also as expected, since the variable is designed to distinguish between months in which the quantity supplied either increases or decreases relative to the previous month.

In the remainder of Table 2, only the constant term changes sign over the 14 different time periods. The Tuesday variable coefficients become less significant as more 1965 data are included in the estimation, indicating some changes in daily marketing habits through the year. Also, the season coefficients become less significant with more 1965 data, probably because some of the months for 1965 do not fit the specification of the variable and their change is in the "wrong" direction.

Table 2. Results of supply equations using aggregated data; dependent variable. $\Delta \log Q_t$

Time period	Independent variables[a]							R^2	d
	Constant term	$\Delta \log P_{t-1}$	$\log M$	$\log T$	$\log W$	$\log F$	$\log S$		
January 1964– December 1964	.0108 (.0252)	8.2771* (.8409)	3.5647* (.3326)	−1.2155* (.3276)	−1.2955* (.3255)	−3.1978* (.3291)	.5219** (.2096)	.7147	2.3516
February 1964– January 1965	.0111 (.0251)	8.1362* (.8466)	3.7462* (.3267)	−1.2139* (.3231)	−1.3486* (.3237)	−3.1675* (.3266)	.4838** (.2070)	.7209	2.4661
March 1964– February 1965	.0168 (.0263)	8.4780* (.8689)	3.6654* (.3430)	−1.3495* (.3392)	−1.4534* (.3392)	−3.3538* (.3426)	.5334** (.2180)	.7108	2.5296
April 1964– March 1965	.0125 (.0292)	8.8183* (.9421)	3.6958* (.3804)	−1.5068* (.3768)	−1.3833* (.3749)	−3.1168* (.3805)	.5157** (.2414)	.6633	2.5513
May 1964– April 1965	−.0015 (.0297)	8.9689* (.9295)	3.9302* (.3861)	−1.2744* (.3828)	−1.2660* (.3828)	−3.0185* (.3848)	.4636*** (.2441)	.6636	2.5290
June 1964– May 1965	−.0127 (.0297)	8.9891* (.9234)	3.9646* (.3841)	−1.1080* (.3815)	−1.1214* (.3816)	−2.8678* (.3857)	.4750*** (.2443)	.6518	2.5104
July 1964– June 1965	−.0135 (.0300)	8.5835* (.9234)	4.0378* (.3885)	−1.0042* (.3846)	−1.0713* (.3830)	−2.8876* (.3883)	.4398*** (.2461)	.6460	2.5204
August 1964– July 1965	−.0255 (.0316)	8.9231* (.9925)	4.0555* (.4117)	− .7049*** (.4053)	− .9763** (.4057)	−2.8305* (.4094)	.4671*** (.2613)	.6146	2.5565
September 1964– August 1965	−.0345 (.0309)	10.3865* (1.0642)	4.1485* (.3985)	− .6160 (.3910)	−1.0934* (.3932)	−2.6898* (.3964)	.5669** (.2541)	.6325	2.5663
October 1964– September 1965	−.0320 (.0316)	9.5947* (1.0805)	4.1327* (.4099)	− .5560 (.4037)	−1.0689* (.4039)	−2.7540* (.4078)	.5015*** (.2618)	.6121	2.6002
November 1964– October 1965	−.0363 (.0325)	9.2909* (1.0907)	4.1901* (.4213)	− .5278 (.4150)	− .9781** (.4150)	−2.6564* (.4194)	.3943 (.2669)	.6005	2.6162
December 1964– November 1965	−.0497 (.0328)	9.6843* (1.0972)	4.4712* (.4263)	− .4714 (.4199)	− .9074** (.4199)	−2.4363* (.4241)	.3442 (.2690)	.6014	2.6216
January 1965– December 1965	−.0350 (.0331)	9.2005* (1.0041)	4.1962* (.4279)	− .5913 (.4192)	−1.1817* (.4191)	−2.5870* (.4223)	.3641 (.2683)	.5916	2.5264
January 1964– December 1965	−.0103 (.0206)	8.5767* (.6453)	3.8536* (.2674)	− .9125* (.2647)	−1.2370* (.2640)	−2.9088* (.2659)	.4400* (.1694)	.6467	2.5184

[a] Standard errors are in parentheses.
* Significant at the 99 percent level.
** Significant at the 95 percent level.
*** Significant at the 90 percent level.

The coefficient of multiple determination for the supply function varies from .5916 to .7209. Again the Durbin-Watson (*d*) statistic can only be used as an approximation, but any *d* statistic larger than 2.45 probably indicates the presence of negative autocorrelation.

Daily Predictions

To appraise the model's overall worth, its predictive power apart from its explanatory power was tested. Predictions of quantity supplied and price were made one successive day at a time for 1965. The procedure used is known as ex post forecasting, in which the known values of the independent variables are inserted into the proper function to obtain an estimate of the dependent variable, which is then compared with the observed value of the dependent variable for that particular day.

Two methods of evaluating the accuracy of the forecasts were used: (1) to measure the percent of correctly anticipated directional changes of the dependent variable out of a given number of predictions; (2) to compute the deviation of the predicted from the actual value and then to represent this deviation (error) both as a percent of the actual value and as Theil's inequality coefficient.[9] Since there are nearly 250 observations for which price and quantity are predicted, these evaluation results have been summed and averaged over given time periods for the purpose of presentation.

Supply predictions

The quantity of live hogs supplied for the aggregated eight markets has been forecasted by two methods for each market day of 1965. In one set of forecasts, referred to as Model 364, only the coefficients of the January–December 1964 estimation are used.

In the other set of forecasts, Model SDC, a different set of coefficients is used for each month predicted. The set of coefficients used for any given month corresponds to the equation estimated from the previous 12 months' data. For example, predictions for March 1965 are based on the March 1964–February 1965 coefficients, those for April 1965 are based on April 1964–March 1965 coefficients, and so on.

The inequality coefficient, average absolute percentage error, and percent of correct directional changes forecasted, summarized by months for

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[9] Theil's inequality coefficient is:

$$U = \sqrt{\frac{1}{n} \sum (P_i - A_i)^2} \Big/ \sqrt{\frac{1}{n} \sum (A_i^2)}$$

where *P* and *A*, representing predicted and actual observations, respectively, are expressed in terms of changes [12]. The smaller the coefficient *U*, the more accurate are the forecasts. In contrast to other inequality coefficients Theil has designed, this one can be larger than 1.

both models, are given in Table 3. The last row of the table shows weighted averages of the 12 months of the corresponding column.

Both models have an average absolute percentage error for 1965 of slightly over 14 percent and nearly identical inequality coefficients near .66. Each model correctly predicts the direction of change more than 80 percent of the time. Predictions of direction are most accurate for January, where all the changes are predicted correctly, and December, where 16 of the 17 changes are predicted correctly. A comparison of the predicted supply corresponding to Model S64 with the actual supply for 1965 can be seen in Figure 1, which illustrates the large daily quantity fluctuations.

Table 3. Summary by months of supply prediction errors for each market day of 1965 for aggregated supply of eight terminal markets

Month	Model S64			Model SDC		
	Theil's inequality coefficient	Average absolute percentage error	Percentage correct direction	Theil's inequality coefficient	Average absolute percentage error	Percentage correct direction
January	.6185	9.91	100.0	.6185	9.91	100.0
February	.5680	16.08	85.0	.5659	16.17	85.0
March	.7175	22.30	69.6	.7149	22.11	69.6
April	.5730	14.74	81.8	.5805	15.04	77.3
May	.5264	11.18	85.0	.5318	11.23	80.0
June	.6965	13.15	72.7	.7156	13.62	72.7
July	.7860	15.35	81.0	.7896	15.60	81.0
August	.4559	9.54	86.4	.4463	9.23	90.9
September	.8022	15.12	85.7	.8107	15.83	85.7
October	.6387	15.77	90.5	.6371	15.43	76.2
November	.5467	15.85	85.7	.5144	14.46	85.7
December	.8365	16.66	94.1	.8978	16.50	94.1
Year, 1965[a]	.6548	14.66	84.3	.6609	14.63	82.7

[a] Weighted average of 12 months' data.

There is very little difference in the forecasting accuracy of the two models, S64 and SDC. Not only are the inequality coefficients nearly identical for the entire year; they are also similar for each respective month. The average absolute percentage error for the year differs between the two models by only 0.03 percent, an average difference in prediction of only nine head a day. The percentage of correct directional changes predicted is nearly identical for the two models also. The important implication is that, for the period under investigation, forecasting accuracy does not appear to improve significantly as a result of applying new coefficients obtained with more recent data. Thus, for this time period, it does not seem necessary to reestimate the supply function month by month, since the forecasts from

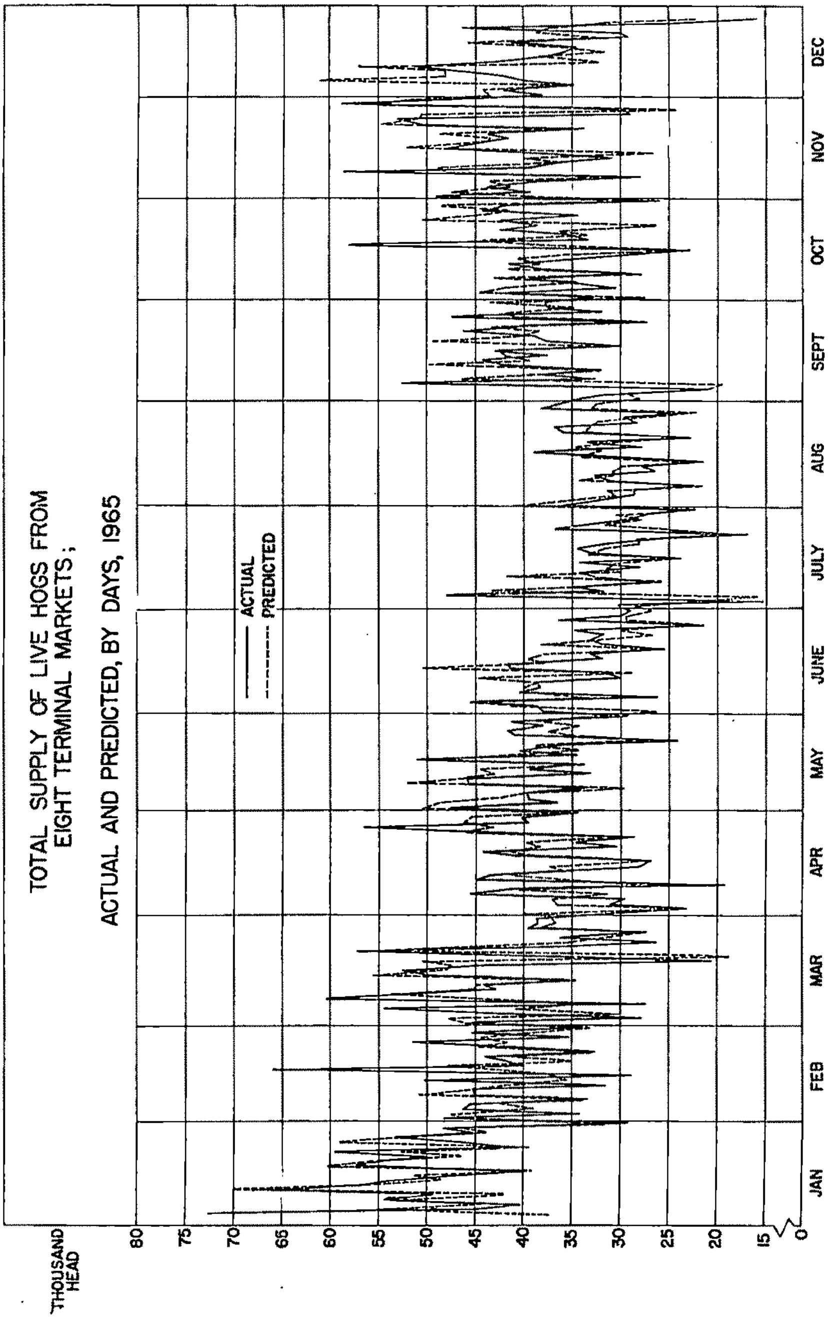
TOTAL SUPPLY OF LIVE HOGS FROM
EIGHT TERMINAL MARKETS;
ACTUAL AND PREDICTED, BY DAYS, 1965
ACTUAL
PREDICTED
THOUSAND HEAD
80
75
70
65
60
55
50
45
40
35
30
25
20
15
0
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC

Figure 1.

the first set of coefficients are not improved upon. This implies that the marketing structure of hogs at the terminal markets did not undergo any large changes over the two-year period, despite the fact that the total supply in 1965 was less than normal, causing prices to get abnormally high later in the year.[10] However, in applying this model into the future, it may be necessary to update it frequently since market behavior could change abruptly.

Price predictions

Price for the aggregated eight markets also is predicted by two methods for each market day of 1965: Model P64 uses only the January–December 1964 coefficients; Model PDC uses different coefficients for each month. Monthly summaries of the results are given in Table 4.

Table 4. Summary by months of price prediction errors for the average price of eight terminals for each market day of 1965

Month	Model P64			Model PDC			Model PN
	Theil's inequality coefficient	Average absolute percentage error	Percentage correct direction	Theil's inequality coefficient	Average absolute percentage error	Percentage correct direction	Average absolute percentage error
January	.5810	.69	68.4	.5810	.69	68.4	1.03
February	.7036	.75	55.0	.7036	.75	60.0	.90
March	.5810	.47	91.3	.5698	.46	87.0	.93
April	.5457	.65	81.8	.5397	.63	77.3	1.24
May	.7350	.75	90.0	.7220	.76	90.0	.96
June	.8404	.95	72.7	.7896	.93	77.3	1.14
July	1.4854	.93	47.6	1.3979	.87	42.9	.64
August	.7718	.45	59.1	.7020	.36	86.4	.56
September	1.1007	1.08	42.9	.9989	.94	52.4	.90
October	.5705	.75	76.2	.5329	.71	71.4	1.27
November	.6749	.65	76.2	.6463	.61	81.0	.88
December	.8147	1.87	64.7	.7659	1.74	70.6	2.33
Year, 1965[a]	.7978	.81	69.1	.7803	.77	72.3	1.05

[a] Weighted average of 12 months' data.

The last row of the table is a weighted average of the months of the corresponding column. Both models forecast with average absolute percentage errors of less than one percent and inequality coefficients of near .80; both correctly predict the direction of change about 70 percent of the time.

Again, there is little difference in the forecasting accuracy of the two models. Model PDC, which uses new coefficients each month, predicts slightly more accurately than Model P64, but not enough to warrant reestimating the demand function each month. This supports the previous conclusion that the hog marketing structure at terminal markets underwent little change during the period of analysis.

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[10] These supply forecasts in aggregate form were not compared with any alternative models, but the supply forecasts for individual markets were compared with USDA daily predictions in [7].

Figure 2, which compares the predicted price of Model P64 and the actual price for 1965, illustrates the accuracy of the predictions. Of course, since each prediction is stated as a change from the previous day's actual price, it is not expected that the predictions would wander much from the actual prices.

As a further test of the predictive capacity of the model developed, price predictions were compared with those of a naive model, PN, in which it was assumed that the price in day t would be the same as the price in day $t-1$ (as in the producer's price expectation model assumed in the supply function). Because the inequality coefficient of Model PN is equal to 1.0, only the average absolute percentage error is summarized in Table 4.

Both Models P64 and PDC forecast more accurately on the average than Model PN, which predicts more accurately only in July and September. In comparing actual average absolute prediction errors, Models P64 and PDC show an improvement in predictive accuracy of 22 and 26 percent, respectively, over Model PN. Thus, the model developed here predicts price more accurately than the next best alternative price forecasting model presently known.

Conclusions and Implications

This analysis of the daily live hog marketing process provides some interesting results and information about the hog economy and its participants. First, the price offered by buyers for slaughter hogs responds relatively very little to daily changes in quantity. However, the quantity supplied in any one day influences price for three consecutive marketing days, suggesting that buyers might take account of the market quantities over a period of days rather than a single day. This implies that storage plays an important role in buyers' daily decision making. In addition, wholesale prices of pork cuts from the previous day, in part reflecting consumer desires, provide signals to the packer about future wholesale prices, causing him to adjust his price bids for slaughter hogs very quickly. Finally, on the demand side, the day of the week influences the buyers' price bids, these being higher at the beginning of the week and lower at the end of the week. This shows that the buyer not only reacts to changes in quantity and product price, but also apparently to internal management decisions, such as labor contracts, which influence the packer's daily operation schedules.

On the supply side, hog producers appear to be extremely responsive to short-run changes in price. A one percent change in price in a given day

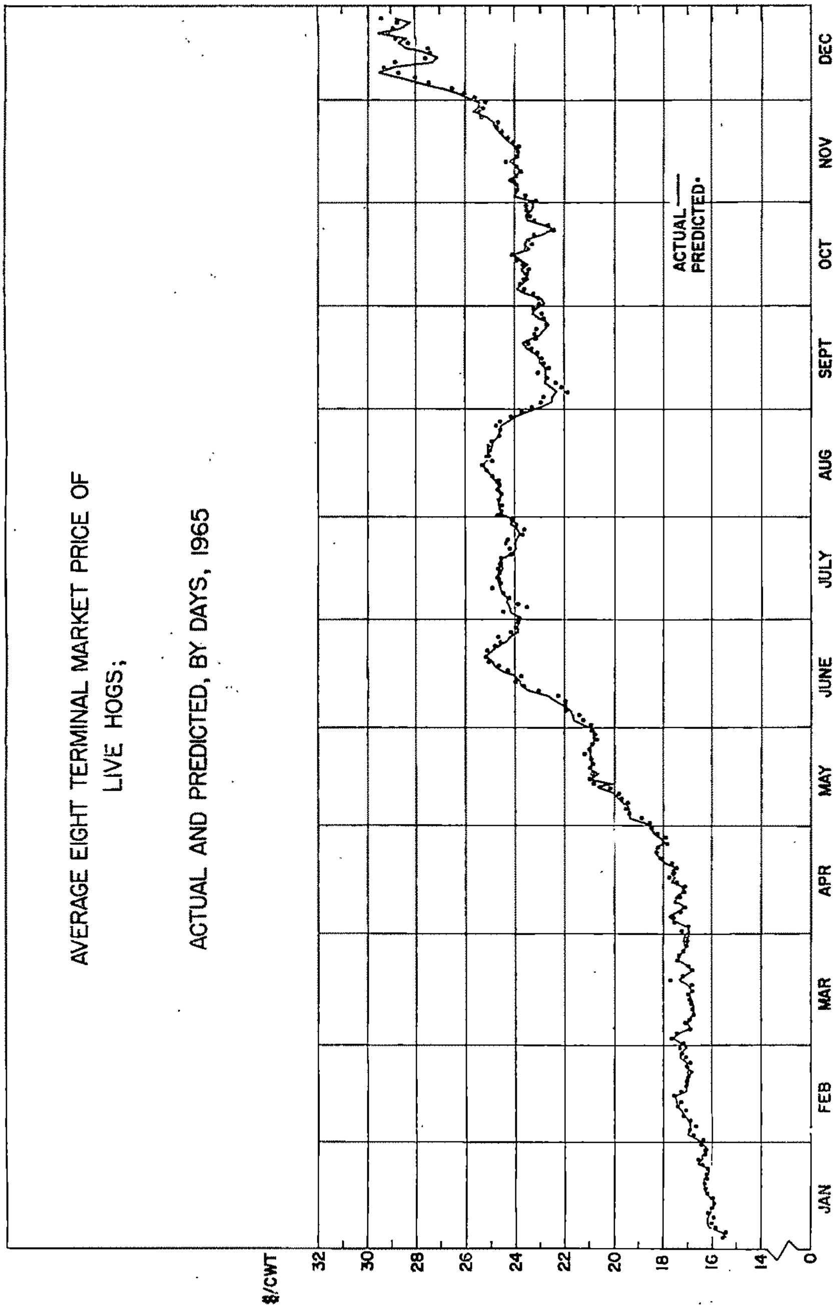
AVERAGE EIGHT TERMINAL MARKET PRICE OF
LIVE HOGS;
ACTUAL AND PREDICTED, BY DAYS, 1965
$/CWT
32
30
28
26
24
22
20
18
16
14
0
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
ACTUAL ——
PREDICTED •

Figure 2.

results in quantity supplied changes the next day of 8 to 10 percent. In addition, the day of the week is important in producer marketing decisions, with marketings highest at the beginning of the week and becoming smaller towards the end of the week. Such a response probably reflects not only traditional marketing habits of producers, but also their reaction to the lower prices offered by packers after the first of the week. Thus, the demand and supply functions indicate that decision making by producers and buyers of slaughter hogs is interrelated through the week as both anticipate particular actions by the other on specific days and both adjust to such exogeneous factors as storage requirements and wholesale price fluctuations.

The small price responses and large quantity responses could have important policy implications, as these may lead to considerable fluctuation of farm incomes and packer profits. The fluctuations in turn may increase uncertainty and inefficiency, creating unnecessary costs in the areas of planning, financing, and risk aversion, which then may call for public and/or private action to reduce such costs. Possible action could include policies to aid packers in controlling stocks or inventories, reducing packer uncertainty and, hence, helping to reduce price and quantity fluctuations. A reduction in quantity fluctuations alone would reduce the costs of inefficiencies not only for packers, but also for stockyard companies and trucking firms who must employ sufficient rescurces to handle the volume of peak days, thereby creating ideal resources on other days. A reduction in price fluctuations should reduce producer uncertainties and related costs.

The predictions made in this analysis indicate that the variations in the coefficients over time had little effect on the forecasts. That is, the appearance of new data in the model did not seem to improve the accuracy of forecasts significantly, implying that if market participants use such a model, re-estimating it frequently over short time periods may be an unnecessary expense, except when market behavior is changing rapidly. This also indicates that the structure of daily marketing within the hog industry at the terminal markets changed very little during the two-year period analyzed. However, before extending these conclusions to either the interior markets or today's terminal market activities, further analysis and updating are probably necessary. Nevertheless, the results of this study undoubtedly can aid present market decision makers.

Finally, this study suggests that similar techniques might be used to analyze short-run fluctuations in other commodities, either jointly or individually. This would aid in the large-scale tasks of providing information and forming policies.

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Factors Associated with Variation in the Aggregate Average Yield of New Zealand Wheat (1918–1967)*

JOHN W. B. GUISE

An apparently successful test of a "step function" hypothesis about the effect of technological change in the agricultural sector is reported. The effects of weather and other factors on wheat yields are also analyzed. A notable feature of the research was the lack of significance of an ordinary time trend variable, used as a surrogate for technological change, when a detailed specification of these factors was developed. Overall, 98.6 percent of the variance of the dependent variable in the sample was accounted for by a regression relationship involving seven weather and four nonweather variables, only one of which related to technological change. The potential value of this relationship for forecasting crop yield is indicated by the fact that the standard error of forecast was substantially less than the standard deviation of errors for the present system of preharvest yield estimation.

STUDIES of the effect of weather conditions on crop yields have been of continuing interest to agricultural scientists for many years. Agricultural economists have become interested in this field of study only in recent years, with the development of attempts to separate the effects of weather and technological change in explaining yield variation [2, 11, 18, 29]. This specialized interest has arisen because of the relevance of technological change in agriculture to economic growth and development generally [12, 13, 16, 23]. An approach that has been adopted in a number of cases to isolate the technological factor [11, 17, 20] is to regress crop yield data on weather variables and a time trend, the time trend being taken as a surrogate for technological change.

Commenting on this approach, Scott [24, p. 657] states that "it is doubtful that development of technology or its subsequent application follows a continuous function. From a statistical stand-point, a time variable may reduce the variance more than can rightfully be accounted for by changes in technology." More specifically, but in similar vein, Shaw [25] argued that technological change in agriculture tends to occur in the form of shifts over a relatively short time period in the general level of yields and that the new levels attained remain constant, apart from the random effects of weather, until another burst of technological change occurs.

If technological change in the agricultural sector does tend to follow an

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irregular step function as Shaw suggests, then, although a time trend may "explain" a high proportion of yield variation over time, it will in fact misspecify the real structure of technological change. This article reports a test of Shaw's "step function" hypothesis about the effect of technological change in the agricultural sector and explores the relevance of certain other factors in explaining wheat yield variation in New Zealand over a fifty-year period.

The Wheat Yield Model

The basic approach to specification in this model is via the production function. It is assumed that wheat yield in any one season, from a particular unit of land, is a function of the inputs of labor and capital in the form of cultivation and harvesting operations, of the basic fertility of the land, of the input of fertilizer, of the incidence of disease and the effects of weather. Aggregating over all land units used for wheat and then averaging, aggregate average yield in any one season will be a function of suitable indices of average inputs of labor, capital, and fertilizer, together with other indices of average land fertility, the incidence of disease, and the effects of weather.

Over an extended time horizon, the level of crop production technology applicable in most pairs of consecutive years is assumed to be comparable, but between certain years, shifts in technology that raise the level of output obtainable from a given level of inputs are assumed to occur. Only technological change occurring in the agricultural sector of the economy is assumed to effect such shifts. Technological change in other sectors of the economy is not treated explicitly, since its effects are reflected in changes over time in the factor and product price ratios relevant to the agricultural sector and hence in the optimum levels of non-farm inputs used in production [14, p. 846].

To handle agricultural technology in the model adopted for the present study, a distinction is made between variables that are regarded as shifters of the intercept of the production surface on the yield axis and variables that are regarded as normal factors of production generating the surface. While several other factors are also treated as shift variables, a specification that allows technological change to effect discrete shifts in output only at certain times differs rather markedly from that usually assumed [1, 11, 22].

A Cobb-Douglas type structure is specified for the normal factors of production in the model but the shift variables are specified in exponential form, thus giving a hybrid character to the model:

$$Y_t = \beta_0 \cdot \beta_1{}^{X}1t \cdots \beta_j{}^{X}jt \cdot X_{kt}{}^{\beta_k} \cdots X_{nt}{}^{\beta_n} \cdot u_t \tag{1}$$

where

Y_t = aggregate average yield of wheat per acre in season t;

β_i = a parameter of the production function where $i = 0, 1, \cdots, n$;

X_{it} = a shift variable affecting the level of output in season t for $i=1, \cdots, j$; and an index of the level of input i in season t for $i=k, \cdots, n$;

u_t = an unobserved stochastic variable assumed to have a log-normal distribution.

To put empirical content into this theoretical model, it is necessary to specify suitable indices for each of the factors considered and to identify the major technological innovations affecting wheat yields.

Specification of Indices of the Variables

A number of conceptual problems relating to the aggregation of micro-relationships into a single macro relationship arise when one attempts to specify indices of inputs [9]. These difficulties and their anticipated effects on the relationships estimated have not been analyzed systematically.

Even for the index of output, average yield, it was apparent that the geometric mean of per acre yields in each year was the appropriate concept to use, rather than the arithmetic mean. Since this was not available, it was necessary to fall back on the assumption that the percentage bias in the index was constant over time and, hence, that its effect would appear only in the regression constant.

Labor and capital inputs

Over the time period considered there has been a substantial shift in the proportions of labor and capital employed as inputs in the form of cultivation, sowing, and weed control operations. However, the environment developed for crop growth has remained substantially the same despite these changes, and hence it may be inferred that they have had a negligible effect on crop yields. For this reason, changes over time in the proportions of capital and labor employed in carrying out these operations were assumed to be compensating, so that their combined effect on yield was approximately constant over the years.

Since labor and capital inputs are notoriously difficult to quantify accurately, this assumption, which provides a suitable representation of the empirical evidence, was most convenient, as it permitted these factors to be included implicitly in the constant and error term of the production function. It is possible however that an important area of technological change has thereby been neglected, as quality changes in both input factors have probably brought about a reduction in the overall commitment of real resources required to prepare the crop environment in recent years. Nevertheless, *in terms of input units of constant quality*, however measured, no such reduction in commitment of real resources is assumed to have occurred.

Labor and capital inputs employed in harvesting operations were assumed to be relevant to the yield relationship only if there had been a change in the relative efficiency of harvesting operations over time, since the demand for these inputs depends upon the yield achieved. Despite the changes in havesting technology, the ratio of potential pre-harvest yield to actual harvested yield, was considered to have been almost constant over the seasons involved.[1]

Fertilizer inputs

Phosphatic fertilizer was the only fertilizer input of any importance for New Zealand wheat production during the fifty-year period under consideration, but a consistent physical measure of this input could not be obtained. Data on total fertilizer usage for all purposes was not available for the earlier years, let alone data relating to fertilizer usage on wheat, so an indirect approach to the specification of fertilizer input was necessary.

In considering the economic factors involved in farmers' decision-making about fertilizer inputs, it seemed logical to conclude that fertilizer usage would increase as the expected price of wheat in the new season increased, relative to the price of fertilizer at time of sowing. The work of Griliches [10] suggested that such a price ratio variable could be regarded as being independent of technological change in the *agricultural* sector of the economy.[2]

The land input

Changes in the average quality of the land used for wheat production in New Zealand may have occurred in three main ways, only one of which involved technological change. First, because wheat production occurs on a number of different soil types, which vary in basic fertility and water holding capacity, a change may occur in average yield when the proportions of the various soil types used to grow the crop are varied. Only one major shift in the proportions of different soil types used to produce the New Zealand wheat crop occurred during the period 1918–1967. This came about between the 1947–48 and 1948–49 seasons as a result of the coincidence of a number of economic factors [15, pp. 55–56]. The simplest way to incorporate this change in the model was to specify a dummy variable as one of the shift factors.

Second, a change in average yield may occur when the size of the wheat crop is varied, even though the proportions of different soil types are held constant. On all soil types, theory would suggest that marginal wheat acres would be less fertile than intra-marginal acres, since they would represent second, third, or fourth crops, depending on land quality, in a rotational system with pastures and other less demanding crops. Wheat acreage harvested was taken as the logical index of this aspect of land fertility, since in the New Zealand context this statistic was equivalent to wheat acreage planted with intention to harvest, which was not available.

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[1] The problem of bias in actual average crop yield reported compared with potential pre-harvest yield, which may arise in most wheat growing regions through crop abandonment in drought seasons, is of little importance in New Zealand because of the relatively favorable climatic conditions experienced, even in so-called "bad" seasons.

[2] For U.S. agriculture as a whole, Griliches found that it was possible to explain almost all the variation in fertilizer consumption over the period 1911–56 on the basis of changing relative prices and the induced learning process these changes brought about.

Third, over the time span considered, an enormous investment in land improvement occurred, and this has changed substantially the average level of fertility of all land used for wheat. The major factor affecting soil fertility was the post-war program of land improvement by the use of lime, fertilizer, certified pasture seeds, chemicals for weed and pest control and intelligent stock management. A feature of this land improvement program was that it was directed primarily toward increasing livestock carrying capacity on pastures, with the improvement in soil fertility for wheat growing being regarded as incidental. The technological changes involved could therefore be regarded as having occurred outside the wheat-growing sector of the economy.

The average level of livestock carrying capacity, per acre devoted to livestock in the major wheat growing areas, was chosen as an appropriate variable to measure the impact of this complex of factors on temporal changes in soil fertility. A series, the detailed derivation of which is given elsewhere [15, p. 109], was developed to measure livestock carrying capacity, using basic data from a number of sources. As with the first aspect of land fertility discussed, it seemed appropriate to specify this variable as a shift factor.

The incidence of disease

A certain incidence of disease may be expected in all seasons, and minor variations in this incidence will contribute to the random error of any regression relationship explaining temporal wheat yield variation.

During the fifty-year period under consideration, there were certain seasons that were unaffected by drought, but when very large reductions in wheat yield occurred nevertheless. Smith and Wright [27, p. 60] state that barley yellow dwarf virus was the most likely cause of these yield reductions.

A dummy shift variable representing virus incidence, which took the value unity in six seasons and zero in all other seasons, was introduced into the regression model to account for this behavior of the dependent variable. The specification of this dummy variable implies that the same percentage reduction in yield was brought about by virus attack in each of these six seasons and that in other seasons the effect of disease factors was so small that it could be neglected.

Weather Factors and Technological Change

During a recent controversy in this journal, Shaw [26] put forward the opinion that "we are unable to specify satisfactorily the relationship between (crop) output and meteorological variables." In replying to this attack on his earlier article [5], Doll [6] put forward his own viewpoint, "that specification, while perhaps not simple, is possible, and should not be abandoned without trial." While not wishing to participate in the original controversy, this author finds himself in agreement with the quoted viewpoint of Doll.

The relationship between crop output and meteorological variables is extremely complex, but no more so than many macro-economic relationships. Despite their complexity, econometricians attempt to estimate macro-economic relationships, using relatively simple functions as approximations to the underlying complex functional relationships of reality, and there seems to be no good reason for rejecting this approach to crop: weather relationships.[3]

Climatic factors affecting New Zealand wheat yields

In 1948 Tauheed [30] made a detailed study of the effect of weather on wheat yields in individual counties scattered throughout the important wheat growing areas of the South Island. Because of the differences in objectives, his work was of only limited usefulness for this study, apart from the rationale it provided for limiting the examination of weather to rainfall and temperature elements. Tauheed examined the importance of a large number of meteorological variables in explaining wheat yield variation and was able to demonstrate that the existing variation in most facets of weather, other than rainfall and air temperature, was not significantly related to wheat yield variation.

Eight variables based on these two facets of weather were specified in the present model. Three of these represented rainfalls in October, November, and December, when soil moisture is normally a limiting factor for plant growth and the wheat crop is making its largest demands on the available supply. A fourth variable was the geometric mean of monthly rainfalls from May to August, which was used as an indicator of the extent of winter drowning on low lying soil types. Abnormally heavy rain in any one or more of these months could detrimentally affect wheat yield.

The remaining four variables related to mean temperatures, but only two had direct effects upon crop yield. Of these, the first was the geometric mean of November and December temperatures, which was used as a measure of the effectiveness of available soil moisture during this period; and the second was February temperature, which indicated the weather conditions during the last half of the harvest. A high proportion of the better yielding wheat crops are harvested during February in New Zealand, and adverse weather conditions at that time may reduce the harvested yield.

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[3] The construction of a weather index along the lines suggested by Stallings [28] and Shaw [25] was not feasible in this case, as no suitable experimental data was readily available in New Zealand.

Indirect effects of weather on wheat yields

The two temperature variables considered to have an indirect effect upon wheat yield were related to the early and late autumn periods, when land preparation and drilling normally occur. The first variable, the geometric mean of February and March temperatures eleven months before harvest, was thought to affect yields through its marginal effect upon the proportions of different soil types used to grow the crop from year to year.[4] Its behavior for this reason would tend to supplement the once for all adjustment effected by the dummy variable discussed earlier.

Late autumn temperatures were thought to affect wheat yields through their relationship with the flight patterns of the cereal aphid (*Rhopalosiphum padi* L.), this aphid being the main carrier of barley yellow dwarf virus from infected pastures to newly emerging autumn sown wheat crops in New Zealand [19, 27]. Low temperatures during April and May reduce aphid numbers and flights, whereas high temperatures have the opposite effect. As a result, wheat yields should be negatively correlated with the geometric mean of temperatures during this period.

Because other factors that occur later in the season are important in determining the spread of virus infection through a crop, this temperature variable could provide only a partial explanation of the effect of the disease on crop yield. However, it may successfully indicate minor variations in yield, resulting from mild virus infections, which were specifically excluded from the dummy variable specified earlier.

Methodology

Ideally, the weather variables used in the regression model should be indices with weights given to meteorological data from a number of stations, according to the area of wheat grown in each locality. In this instance, because of resource limitations, only data from the Lincoln Meteorological Station were used in defining these variables.

For this to be acceptable, it is necessary that strong correlations exist between the weather pattern experienced in this locality and that experienced in other wheat growing districts. In tests with meteorological data from centers in other important wheat growing districts, simple correlation coefficients with $r > 0.7$ for rainfall data and $r > 0.8$ for temperature data were obtained in all cases, so this requirement is fairly well satisfied.[5]

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[4] No serial correlation between this variable and February temperature at harvest was apparent in the data ($r = -0.044$).

When the weather factors were incorporated in the model, it seemed appropriate to treat the rainfall variables as normal production inputs and the temperature variables as shift factors.[6] Crop-water relationships are at present the subject of intensive research by both biological scientists and production economists [7], so no claim to biological accuracy is made for this specification.

Technological change

The final variables requiring specification were those concerned with technological changes that directly affected wheat yields. Serious attempts to breed improved wheat varieties in New Zealand began sixty years ago with the work of Hilgendorf at Lincoln College. The progress of this work over the intervening years has been summarized recently by Copp [4]. The first major achievement was the breeding of Cross 7, which was released commercially for the 1934–35 season. This variety possessed excellent milling and baking qualities and was much more suitable for direct heading than the varieties it replaced, but it gave no increase in yield per acre [4, p. 79].

For over twenty years, until the varieties Arawa and Aotea [3] were released in the 1956–57 and 1957–58 seasons, respectively, Cross 7 was the main wheat variety in New Zealand. These new wheats were quickly adopted after showing yield increases in field trials of 17 percent (Arawa) and 25 percent (Aotea) over that obtained with Cross 7 [4, p. 83]. In the 1957–58, 1958–59, and 1959–60 seasons, respectively, these varieties made up 44, 63, and 92 percent of the total wheat received for flour milling. An improved strain of Hilgendorf, a variety of very high baking quality but lower yield, was introduced for the 1961–62 season and became commercially important from the 1963–64 season because it attracted a quality premium.[7]

As an index of these technological changes a variable was specified that indicated the proportion of the total crop acreage made up by the area of

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[5] In a study of wheat yields in France, Oury [21] found that one set of meteorological data from a centrally located recording station gave regression results very similar to those obtained when weighted weather data from many relevant locations were used. This too, suggests that the use of weather data from only one location in the present study should not prove overly restrictive.

[6] The lowest monthly rainfall recorded in these months, over the seasons considered, was 0.12 of an inch. For this reason, no complications such as would occur with a rainfall record of zero were encountered using this specification.

[7] This wheat variety, named after the pioneer breeder, was first introduced in the 1947–48 season, but was not widely grown because its yield was lower than that obtained with Cross 7. The improved yield of the new strain, together with a 20 cent premium per bushel, has changed this situation, and seed of the Hilgendorf variety has been used to plant approximately a quarter of the crop area in recent years.

Aotea plus two thirds of the area of Arawa in each season.[8] This specification was chosen because it allowed for the time that elapsed before the new high yielding varieties were completely adopted and also took account of the movement away from these varieties in the most recent seasons because of the premium paid for the new strain of Hilgendorf (a wheat with a yield similar to that obtained from the old Cross 7 variety). As an alternative more conventional measure of technological change, an exponential time trend was also specified.

Estimation of the Wheat Yield Model

Data for each of the variables discussed in the previous sections, relating to the fifty seasons from 1917–18 to 1966–67, were utilized in the estimation of the regression model.[9] A (common) logarithmic transformation of the model specified in equation (1) was carried out prior to estimation using the method of least squares. Initially, the influence of the weather variables on wheat yields was assumed to be random because their simple correlations with the dependent variable were very low. For this reason they were excluded from the first stage of estimation in which a step-wise regression procedure was used with the remaining variables.

Best two, three, and four independent variable regressions were estimated, the last of these being

$$\begin{aligned}(2)\qquad \log \hat{Y}_t = \underset{(0.0059)}{1.5123} &+ \underset{(0.0108)}{0.1049X_{1t}} - \underset{(0.0129)}{0.0980X_{3t}} + \underset{(0.0182)}{0.0753X_{8t}} \\ &+ \underset{(0.0351)}{0.1415 \log X_{10t}} \\ R^2 &= 0.900, \qquad d = 1.960\end{aligned}$$

where the figures in brackets refer to the standard errors of the partial regression coefficients and the variables have the interpretation:

X_1 = a dummy variable representing the shift in the proportions of various soil types used for wheat in the 1948–49 and subsequent seasons;

X_3 = a dummy variable representing virus incidence;

X_8 = a variable indicating the proportion of wheat acreage each season which was planted in the high yielding varieties Arawa and Aotea;

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[8] This specification was used to combine the effects of the two wheats in terms of "Aotea equivalents" since the yield increase from Arawa was only two-thirds the increase from Aotea. After initial popularity, Arawa has been much less widely grown than Aotea in recent years.

[9] For detailed discussion of data sources and the data series for the seasons up to 1963–64, see [15].

X_{10} = the ratio of expected wheat price per bushel at harvest, to fertilizer price per hundred weight, at planting time each season.[10]

All partial regression coefficients were significant at the one percent level and the Durbin-Watson "*d*" statistic appeared to be satisfactory.

The five independent variable regressions obtained when the other non-weather variables were tested with the set of independent variables used in equation (2) were:

$$\begin{aligned}(3)\qquad \log \hat{Y}_t = \underset{(0.0955)}{1.4755} + \underset{(0.0172)}{0.1100}X_{1t} - \underset{(0.0130)}{0.0983}X_{3t} + \underset{(0.0235)}{0.0697}X_{8t} \\ + \underset{(0.0368)}{0.1453}\log X_{10t} + \underset{(0.0406)}{0.0157}\log X_{11t}\end{aligned}$$

$$\begin{aligned}(4)\qquad \log \hat{Y}_t = \underset{(0.0338)}{1.5496} + \underset{(0.0150)}{0.1163}X_{1t} - \underset{(0.0256)}{0.0288}X_{2t} - \underset{(0.0124)}{0.0945}X_{3t} \\ + \underset{(0.0270)}{0.0858}X_{8t} + \underset{(0.0436)}{0.1703}\log X_{10t}\end{aligned}$$

$$\begin{aligned}(5)\qquad \log \hat{Y}_t = \underset{(0.0185)}{1.5082} + \underset{(0.0290)}{0.0986}X_{1t} - \underset{(0.0130)}{0.0982}X_{3t} + \underset{(0.0193)}{0.0740}X_{8t} \\ + \underset{(0.0013)}{0.0003}X_{9t} + \underset{(0.0789)}{0.1250}\log X_{10t}\end{aligned}$$

where

X_{11t} = wheat acreage harvested each season;

X_{2t} = livestock units per acre devoted to livestock each season; and

X_{9t} = a time trend with origin at 1st February 1917 and units of one year.

In none of these cases did the coefficient of multiple determination differ significantly from the figure obtained for equation (2). The added variables in equations (3) and (4) have a partial regression coefficient of wrong sign compared with a priori expectations as a result of multicollinearity with the other independent variables. In equation (5) the partial regression coefficient of the exponential time trend variable, X_9, was less than a quarter the size of its standard error despite the fact that this variable had the highest simple correlation with wheat yield of all those examined.[11]

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[10] Extrapolative expectations were assumed for wheat pricing, except on certain occasions during the last thirty years of government price control, when the announcement of the (changed) new season's price occurred before planting time.

[11] This was $r = 0.84$. The simple correlation coefficients obtained between the dependent variable and each other non-weather variable examined were significantly different from zero at the one percent level and of correct sign.

Estimating the effects of weather

Although the simple correlations between the weather variables specified and wheat yield were rather disappointing, the partial correlations obtained after allowing for the variables X_1, X_3, X_8 and X_{10} ranged up to $r=0.61$. The full model, including the weather variables, together with the independent variables of equation (2), was then estimated, again using the stepwise technique. The final equation obtained, which included eleven independent variables was

$$
\begin{aligned}
(6)\quad \log \hat{Y}_t = {} & \underset{(0.0999)}{1.3311} + \underset{(0.0047)}{0.0878X_{1t}} - \underset{(0.0054)}{0.0986X_{3t}} + \underset{(0.0121)}{0.0521X_{4t}} - \underset{(0.0159)}{0.0721X_{5t}} \\
& + \underset{(0.0090)}{0.0368X_{7t}} + \underset{(0.0076)}{0.0848X_{8t}} + \underset{(0.0160)}{0.1390 \log X_{10t}} \\
& - \underset{(0.0145)}{0.0651 \log X_{12t}} + \underset{(0.0052)}{0.0506 \log X_{13t}} + \underset{(0.0077)}{0.0699 \log X_{14t}} \\
& + \underset{(0.0047)}{0.0229 \log X_{15t}}
\end{aligned}
$$

$$(R^2 = 0.986;\ d = 1.960)$$

where

X_4 = the geometric mean of February and March (pre-planting) mean temperatures, in units of 10°F;

X_5 = the geometric mean of April and May mean temperatures in units of 10°F;

X_7 = February (harvest) mean temperature in units of 10°F;

X_{12} = the geometric mean of rainfalls in the months May to August in units of one inch;

X_{13}, X_{14} and X_{15} = October, November and December rainfalls, respectively, in units of one inch.

When the variable X_6 (November–December mean temperature) was added to the set of independent variables used in equation (6) the partial regression coefficient obtained in the resulting regression relationship was smaller than its standard error, although of correct sign, while the significance of the other variables was unaffected.

One feature of equation (6), compared with equation (2), are the changes that occurred in the relative size of the partial regression coefficients of the variables X_1 and X_8, when weather effects were allowed for. This suggests that the weather experienced in the set of seasons 1948–49 to 1966–67 was relatively better on average than that in the earlier seasons considered. Consequently, the regression coefficient of the variable X_1 appears to have been inflated by this effect in equation (2), where no explicit allowance was made for weather.

On the other hand, the weather experienced in the sub-set of seasons from 1957–58 to 1966–67 would appear to have been worse than the average of the set of seasons 1948–49 to 1966–67 with the consequent effect that the coefficient of the variable X_8 was underestimated in equation (2), when no explicit allowance was made for weather.[12] These features of the regression results suggest that it may not always be safe to neglect weather effects in time series production function analysis, even when primary interest centers on the estimation of regression coefficients for economic variables open to manipulation by policy makers.

Discussion

The lack of significance of the smooth time trend variable tested in equation (5) as a surrogate for technological change, together with the high level of significance of the specific technological change variable X_8, in equation (6), provide some support for Shaw's hypothesis, that technological changes in specific sectors of the economy tend to be introduced fairly abruptly and at irregular intervals.

Although an exponential time trend, taken alone as a regressor, could reduce by 70 percent the variance of the dependent variable about its (conditional) mean, a more detailed specification of the factors affecting wheat yields permitted a reduction in variance of 98.6 percent without including this surrogate variable. The results obtained certainly support Scott's contention [24, p. 657] "that a time variable may reduce the variance more than can rightfully be accounted for by changes in technology."

When the logarithmic partial regression coefficient of the variable X_8 was evaluated, an expected increase in wheat yield of 21.5 percent was indicated if the variety Aotea was to replace Cross 7 over the entire crop area. This figure is quite close to the increase of 25 percent predicted on the basis of regional trials prior to the release of this wheat.

On evaluating the anti-logarithm of the partial regression coefficient obtained for the variable X_3, an expected decline in yield of 20.3 percent is indicated if a virus attack as severe as those experienced in the past should recur. This figure suggests that the high priority given in recent years to scientific research into control measures for this disease has considerable economic justification.

The effect of the abrupt shift in the proportions of different soil types utilized for wheat growing between the 1947–48 and 1948–49 seasons may be assessed from the anti-logarithm of the partial regression coefficient of the variable X_1. This indicates that a sustained yield increase of approximately 22.4 percent occurred, following the move away from wheat on the less fertile and more drought prone soil types.

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[12] These observations were supported by an ex-post analysis of estimated weather effects in each season.

For each of the other variables included in equation (6), the expected effect on aggregate average wheat yield of a movement one standard deviation above or below the mean value of the regressor has been set out in Table 1. A yield of 47.15 bushels per acre has been taken as the base point for these measurements, this being the expected yield when $X_1 = 1$, $X_3 = 0$, $X_8 = 0.70$, and all the other regressors take their sample mean values.[13]

Table 1. Estimated effects of variation in certain regressors on aggregate average wheat yield

Regressor	Mean value in sample	Value one standard deviation above mean	Effect of this variation on average wheat yield	Value one standard deviation below mean	Effect of this variation on average wheat yield
			bushels		bushels
Wheat/fertilizer price ratio (X_{10})	1.153	1.548	+1.97	0.859	−1.90
October rainfall (X_{13})	1.451 (inches)	3.258	+1.97	0.646	−1.90
November rainfall (X_{14})	1.795 (inches)	3.112	+1.85	1.035	−1.79
December rainfall (X_{15})	1.811 (inches)	4.279	+0.93	0.765	−0.92
May–August mean rainfall (X_{12})	1.986 (inches)	2.651	−0.88	1.488	+0.89
Early autumn mean temperature (X_4)	59.70 °F.	61.26	+0.88	68.14	−0.88
Late autumn mean temperature (X_5)	50.36 °F.	51.76	−1.09	48.96	+1.10
Harvest mean temperature (X_7)	61.44 °F.	63.43	+0.80	59.44	−0.80

During the last five years of the sample period the wheat-fertilizer price ratio took values nearly a standard deviation above its mean; but following recent increases in fertilizer prices, it has fallen to a value close to the sample mean, thus reducing future yield expectations by approximately 2 bushels per acre.

Among the weather variables, October and November rainfalls appear to have the most critical influence on wheat yield, but each of the other factors isolated apparently can effect year to year variations in yield of the order of ±2 percent fairly frequently. In many instances, the effects of individual influences tend to offset each other, but when several factors move in the same direction together, their combined influence on yield can be very substantial.

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[13] These values for the variables X_1, X_3 and X_8 were relevant to the situation in the 1967–68 season. The standard error associated with the figure of 47.15 bushels per acre was approximately 0.45 bushels.

In the 1966–67 season, a record average yield of 55.42 bushels per acre was obtained, but favorable weather conditions appear to have been responsible for 6.8 bushels per acre of this yield. By way of contrast, during the 1961–62 season almost all the weather factors were adverse. The yield of 42.06 bushels per acre obtained that season was apparently affected to the extent of 8.1 bushels per acre by the difference between actual and mean weather conditions.

Conclusions

Attention has been focused, in this paper, on various factors that have affected annual aggregate average wheat yields in New Zealand over a fifty-year period. It may be claimed that the regression equation (6) provides a satisfactory analysis of the specific factors associated with yield variation and that, as a result, their relative importance may be estimated. Probably the most interesting finding was that, after allowing for the specific effect of virus disease, for a shift in the proportions of different soil types utilized for the crop, and for changes in an important factor/product price ratio, the only significant technological changes that directly influenced wheat yields were those relating to the introduction of new wheat varieties.

Although an exponential time trend, which might be interpreted as a surrogate for gradual technological change, was more highly correlated with the time series of yields than any other single regressor examined, it failed to attain significance in the multiple regression relationships. The (quite plausible) mis-specification of the effect of technological change on wheat yields, which would have resulted if this time trend variable had been accepted uncritically, should provide a warning for future researchers seeking to separate technological and weather factors when analyzing changes in agricultural productivity.

While the specification of weather factors adopted in this study may be criticized as over-simplified, it does appear to provide reasonable quantitative estimates of the influence of weather on wheat yields. Simple functions of specific weather elements, such as those used here, can never capture all the nuances of weather, but crop yield response often appears to be closely associated with gross changes in certain facets of weather. If the inadequacy of a postulated relationship of this type as a biological explanation of crop response is fully recognized by agricultural economists, there seems to be no good reason, other than pedantry, for eschewing its use, when analyzing technological change over time or forecasting crop yields.

In the present instance, equation (6) seems to be suitable for the specific use of forecasting wheat yields, as well as analyzing the per acre productivity of wheat in New Zealand. This attribute may be important to the New Zealand Wheat Board, which is responsible for ensuring that adequate supplies of milling wheat are available throughout the country at all times and to the transport and flour milling industries in arranging to meet the seasonal demand for transport and storage facilities. At present, pre-harvest estimates of yield are made by the Department of Statistics on the basis of district surveys by Department of Agriculture officers, but the results are not normally published until April or May.

Final yield figures for the 1967–68 season are not yet available, but the pre-harvest estimate of yield was 48 bushels per acre.[14] A guide to the accuracy of this figure may be obtained by estimating the standard deviation of the differences between these estimated yields and actual yields over the previous fifteen years for which comparable estimates were available. The calculations, made without taking logarithms of the data, gave a value of 2.14 bushels per acre for the standard deviation. Using equation (6) for the purpose of forecasting yield, a point estimate of 49.19 bushels per acre was obtained, with a standard error of forecast close to 1.50 bushels per acre.[15] The accuracy of this figure and the usefulness of updated versions of the model for forecasting future yields are matters that time alone can determine.

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[14] Figures released by the Department of Statistics in February 1969 suggest that a provisional final yield of approximately 51.93 bushels per acre will be obtained.

[15] In logarithms, the forecast was 1.691919 ± 0.013143. As Goldberger [8] has pointed out recently, this point estimate relates to the conditional median rather than the conditional mean of the distribution of yields. Using the adjustment procedure he suggests, a conditional mean of 49.99 bushels per acre is obtained.

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Development of Soviet Agriculture Under a Vintage Model of Production*

Earl R. Brubaker

The purpose of this paper is to examine within the framework provided by a vintage model of productive activity the pertinent evidence on output, inputs, and the age of fixed capital to further understanding of the sources of growth (1928–62) in Soviet agricultural output. The basic procedure consists of tentatively accepting the embodiment hypothesis, which states that any positive growth in factor productivity is the consequence of improved quality of fixed capital. Data on the age of capital are taken as indicative of its technological quality, and implied rates of growth in such quality are computed as a residual. Conclusions drawn from strict acceptance of the hypothesis are tempered to account for additional qualitative evidence and for the possibility that equipment may be a more effective carrier than structures. Everything considered, it seems that the embodiment hypothesis can make a useful contribution to understanding Soviet agricultural development.

SEVERAL careful studies have suggested recently that long-term trends in output of the agricultural sector, like those of an aggregate economy, often can be explained only partially by the corresponding trends in traditionally measured factors of production [14; 21, p. 45]. As a matter of fact, in a number of developed countries, among them the United States [21, p. 57], Canada, the United Kingdom, and the German Federal Republic [9], it seems that for substantial periods the growth of factor productivity[1] on the farm matched or exceeded that of other major sectors.

In the Soviet Union, where right up to the present farming has occupied an especially prominent position in what has become a leading industrial economy, analysis of agricultural productivity is of special interest. Understandably, several attempts have been made to relate trends in Soviet farm output to changes in measurable factor inputs [8, 11, 18]; and for the long-term (1928–62) as well as for the "normal" postwar period, there again appears something of a tendency for growth of output to be faster than that of inputs. The purpose of this paper is to examine, within the framework provided by a vintage model of productive activity, the pertinent evidence on output, inputs, and age of fixed capital, in an attempt to further understanding of agrarian development under Soviet-style socialism.

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[1] In this paper, factor productivity refers to output per unit of combined inputs.

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Some Basic Statistical Measures

A summary of the results of a vast and painstaking research effort aimed at obtaining a body of reasonably consistent, long-term, well-defined, and reliable time series gleaned from observation of the Soviet farm sector appears in Table 1. The time periods reflect in part the availability of data and in part an attempt to choose, where information is available, initial and terminal years in which the effects of weather have been judged to be similar, i.e., 1953, 1957, and 1962.[2] Generally the data are from a single monograph, *The Soviet Capital Stock, 1928–1962*, by Moorsteen and Powell [22], but they in turn have drawn when necessary, at times heavily, on the work of other Western researchers.

Table 1. Growth in Soviet agricultural output and inputs, selected periods, 1928–62

Period	Output	Employment	Fixed capital stock			Livestock	Land	Current inputs
			Structures	Equipment	Total			
	average annual percentage change							
1928–37	1.9	0.1	6.9	15.7	8.7	−4.6	2.0	19.4
1953–57	7.6	2.0	7.4	16.2	10.6	2.2	5.4	5.2
1957–62	3.8	0	10.9	7.5	9.5	4.8	2.2	7.2
1953–62	5.5	0.9	9.3	11.3	10.0	3.6	3.6	6.3
1928–62	2.4	0.6	6.0	9.7	6.9	0.3	1.9	9.1

Source: Computed from data in Appendix Table A.1.

Variables measured in value terms are based on data in 1937 prices except when, for analytical reasons [22, p. 281], 1928 prices seem more ap-

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[2] According to Douglas B. Diamond [8, p. 347] the weather may be described as follows:

Year	Growing conditions	Year	Growing conditions
1950	slightly favorable	1957	normal
1951	subnormal	1958	exceptionally favorable
1952	slightly favorable	1959	unfavorable
1953	normal	1960	normal
1954	normal	1961	above average
1955	normal	1962	normal
1956	above average		

Diamond also suggests that conditions for producing livestock products reflect the weather with a one-year lag. Thus, farm output in 1957 and 1962 have been judged to be similarly affected by weather in both the major farm sectors. Apparently 1953 differed from 1957 and 1962 only with respect to slightly less favorable conditions for producing livestock products, so that comparisons involving average annual rates of growth of output based on 1953 may reflect a slight upward bias. Given that livestock products probably contributed less than half of agricultural output and that a presumably small measurement error is being averaged over a four-year period, it would seem reasonable to expect that any bias would be quite modest.

propriate. In many cases alternative measures in 1928, 1950, or 1955 prices are available, but in general they result in quite similar quantitative conclusions. In any event, the principal purpose here will be to attempt an interpretation of the data based on the assumption that the measurements reflect valid approximations of the "true" values of the variables.[3]

Sources of Growth

Simple inspection of the data on inputs in juxtaposition with those on output can give considerable insight into the connections between them. But even in preparation of these data, substantial assumptions about economic relationships were necessary.[4] If we are willing to experiment with some hypotheses about the lines of interdependence between the variables, it might be possible to comprehend better the Soviet Russian agricultural productive process.

Previous investigators have followed a variety of procedures. Karcz [19] lists and inspects the measures on the various inputs separately, with no attempt at aggregation. Diamond [8] and Johnson [18] consider hypotheses about the nature of the agricultural production function. Johnson expresses the economist's usual preference for the Cobb-Douglas version but, for purposes of comparability with studies of the United States, turns to the infinite-elasticity-of-substitution function; Diamond chooses to aggregate his inputs geometrically. In this study, we employ as the basic analytical framework the embodiment or "carrier" hypothesis, which permits consideration of some additional pertinent information, namely, data on the age of fixed capital.

The carrier hypothesis states essentially that the principal reason for productivity gains has been technical advance embodied in new capital items that reflect in their design and construction a multitude of advances in science and technology. This hypothesis has enjoyed tremendous initial appeal, at least to some degree, because of its consistency with wide varieties of everyday experience as well as with systematic historical descriptions of basic scientific and technological developments. It may be stated fairly rigorously as follows:

$$\text{(1)}\quad \frac{\Delta 0}{0} \approx \left| \frac{\Delta A'}{A'} + d\lambda + \frac{d\lambda(-\Delta\bar{a})}{1 + \lambda(-\Delta\bar{a})} \right| + b\frac{\Delta L}{L} + c\frac{\Delta B}{B} + d\,\frac{\Delta K}{\mathrm{K}} + e\,\frac{\Delta M}{\mathrm{M}} + f\,\frac{\Delta P}{\mathrm{P}}$$

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[3] In fact, the measures doubtlessly only approximate the magnitudes desired for analytical purposes. The data on capital are particularly suspect, and a comparison with the work of other investigators is made in Appendix A.

[4] It is assumed, for example, that ruble factor costs are indeed appropriate weights for arithmetically aggregating outputs and inputs.

where

$$\frac{\Delta 0}{0}, \frac{\Delta L}{L}, \frac{\Delta B}{B}, \frac{\Delta K}{K}, \frac{\Delta M}{M}; \quad \text{and} \quad \frac{\Delta P}{P}$$

represent the average annual percentage growth in output, labor, land, fixed capital, livestock, and current purchases, respectively; b, c, d, e, and f are the partial elasticities of output with respect to the corresponding inputs;[5] $\Delta A'/A'$ is the percentage growth in factor productivity not attributable to embodied technical change; λ represents the growth in quality of fixed capital; and $\bar{a}$ represents the average age of fixed capital.[6] The hypothesis thus

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[5] Shares in gross agricultural income in 1937 are taken as approximations of the numerical values of the partial elasticities. The derivation proceeds as follows: Shares for labor, capital, and land implied in [22, p. 371] under alternative assumptions about the interest rate, i.e., as low as eight percent or as high as twenty percent, are averaged. Allocations are made to fixed capital and farm animals in proportion to the valuation of their stocks. The share of current purchases is set at 0.082 [18], and the rest are adjusted so that the sum is one hundred. The result is:

Input	Share
Labor	0.5496
Current purchases	0.0820
Land	0.2185
Livestock	0.0623
Fixed capital	0.0886
Structures	0.0642
Equipment	0.0244

[6] For the convenience of the reader, a summary of the genesis of (1) is presented here. First we recall that, granted certain conditions, the production function with disembodied technical change may be written

$$\frac{\Delta 0}{0} = \frac{\Delta A}{A} + b\frac{\Delta L}{L} + c\frac{\Delta B}{B} + d\frac{\Delta K}{K} + e\frac{\Delta M}{M} + f\frac{\Delta P}{P} \tag{2}$$

where $\Delta A/A$ is a residual including the effects of all factors other than inputs of labor and capital, both of which are unadjusted for quality change. By substituting $\Delta J/J$, the rate of growth of quality-adjusted fixed capital stock, for $\Delta K/K$ and, accordingly, $\Delta A'/A'$ for $\Delta A/A$, we obtain

$$\frac{\Delta 0}{0} = \frac{\Delta A'}{A'} + b\frac{\Delta L}{L} + c\frac{\Delta B}{B} + d\frac{\Delta J}{J} + e\frac{\Delta M}{M} + f\frac{\Delta P}{P} \tag{3}$$

The quality-adjusted capital input is defined as

$$J_t = \sum_{v=0}^{t} K_{vt}(1 + \lambda)^v \tag{4}$$

where t is the date of measurement and v, the vintage, is the date of investment. Thus in weighting the capital items, their age is taken as a proxy for their "quality," which improves at a rate of λ percent each year. It can be shown that

$$\frac{\Delta J}{J} \approx \frac{\Delta K}{K} + \lambda - \frac{\lambda \Delta \bar{a}}{1 + \lambda(-\Delta \bar{a})}\,. \tag{5}$$

The first two terms on the right hand side of (5) approximate the rate of growth of the quality refers to relations between variables on which we have already presented much information but calls also for evidence on three more—growth in the quality of fixed capital stock, its average age, and the net impact of all other factors affecting the growth of output.

The carrier hypothesis, like other production functions, is a statement pertinent to any level of aggregation. It has been made about entire economies including, therefore, the farm sector; and indeed a recent study [26, pp. 975ff] has concluded that technological improvements carried by capital did contribute significantly to growth of output on Israeli *kibbutzim*. The hypothesis is not without plausibility in reference to agriculture in the United States,[7] and at least one analyst of Soviet farming has suggested that availability of the proper machinery is especially important in the USSR where, because of climatic limitations, it is imperative to accomplish such basic tasks as plowing, seeding, and harvesting within an exceedingly short period of time [19].

In the current state of economic knowledge, it is possible to obtain quantitative evidence compressed into a single indicator regarding only one of the added variables, the average age of fixed capital. Taken as a proxy for the average quality of capital, age is in its own right an interesting variable.[8]

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adjusted capital stock when there is no change in its average age. The third term provides an adjustment to account for changing $\bar{a}$.

Substituting the right-hand side of (5) for $\Delta J/J$ in (3) and rearranging terms, we obtain (1). The interested reader may find a more detailed account of the derivation, with an implementation using data on the aggregate U. S. economy in [23] and a thorough discussion of production functions and technical change generally, in [2].

[7] Griliches [13] has argued that increasing capital quality is an important reason for the apparent rise in factor productivity as often measured for farming in the United States. William McD. Herr [14] also implies that physical capital may be an important carrier of technical advance.

[8] Moorsteen and Powell [22, p. 307], have questioned the use of age as a proxy for quality in the Soviet case because " . . . there is no satisfactory way to date the technology embodied in assets created in any given year." The dating problem stems in part from long periods of production for certain items of equipment.

But the fact that a given model is produced over a long period would not seem to preclude dating of *average* embodied technology. Suppose, for example, that investment is composed of only two capital items, automobiles and carriages, with the former accounting for 5 percent of the total in year 1 and carriages accounting for the remaining 95 percent. Suppose further that 20 years later the shares were reversed. The average technology embodied in the items from the later year would differ substantially from that in the initial year without any model change whatsoever. In fact the piece of equipment perhaps most instrumental in transforming the American economy in recent history, the automobile, gained preeminence through the production of a single model, Ford's model T, for close to 20 years. In a large sector of an economy with many productive activities and a large number of capital items, long model runs would be entirely consistent with fairly steady progress in the aggregate. Thus, technology may very well be regarded as advancing in quantum jumps, introducing a new item with a technique doubly, triply, or even a hundred fold more productive. This model may be produced for a number of years, replacing the item that formerly filled that need. With many innovations in many different productive activities over a number of years, the aggregate process may not be exactly continuous, but the model assuming continuity in the aggregate and on the average may provide a useful approximation to the "truth" in all its complexity. Thus, it would seem

Considered in conjunction with the embodiment hypothesis, it may prove to be even more useful. While some interesting evidence is summarized below, ultimately it is necessary to make an essentially arbitrary assumption about the net quantitative significance of the numerous other factors that might plausibly be connected with changes in productivity. In this paper it has been assumed that in the postwar period unspecified factors, on balance, neither detracted from nor contributed to changes in productivity. It seems likely, therefore, that values for λ, which are computed as a residual, and the absolute values for $d\lambda(-\Delta\bar{a})/1+\lambda(-\Delta\bar{a})$, which in turn depend on λ, are subject to some upward bias.[9]

Paying special attention to the periods chosen for analysis, let us consider now the available information on the age of Soviet agricultural fixed capital (see Appendix Table A.2). The basic pattern of change from period to period resembles in many respects that for the total fixed capital stock [22, p. 336], but important differences do appear. There is a moderate decline in the prewar period amounting to little more than a year between 1928 and 1937. The wartime and postwar changes are rather more dramatic. Thus the available data suggest that the low investment during World War II prompted a rise in $\bar{a}$ to a postwar peak, 15.5 years, that substantially exceeded the 1928 level. But in the 1950's, when investment and retirement of structures accelerated, it declined at a truly spectacular rate to a three-decade, and quite probably alltime, low, 6.6 years, by the latter 1950's. But then the average age stabilized and even showed some tendency to rise again[10] as the growth of fixed capital stock abated. Thus, in Soviet agriculture too, variations in the average age of fixed capital have been prominent.

What are the implications of these variations for the sources of growth in

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that a dating problem because of long model runs does not eliminate the possibility that a relatively thorough and rigorous investigation of the implications of accepting the embodiment hypothesis may help to clarify its usefulness for contributing to our understanding of growth of agricultural output in the USSR.

It also has been suggested that, because of the perennial dire shortages of spare parts in the Soviet Union, a significant effect of changing average age of equipment may be changing of the fraction operable during the course of a given year. To the extent that this is so, our estimates of the impact of embodied technology are biased in a direction inverse to the movement of $\bar{a}$.

[9] By assuming $\Delta A'/A'=0$, we have

$$\frac{\Delta A}{A} = d\lambda + \frac{d\lambda(-\Delta\bar{a})}{1+\lambda(-\Delta\bar{a})}\,.$$

This quadratic in λ is solved for positive roots only.

[10] The rapid decline in the postwar period as computed here stems to a considerable extent from retirements of aged structures, and their actual occurrence is open to doubt. Therefore a recomputation on the alternative assumption that all structures continued to be used seemed in order The basic pattern remains, however, as the decline in $\bar{a}$ amounted to -0.56 years per year in 1950–58, for example, as compared with -0.94 years per year before, while in 1958–61 there is essentially little change, -0.1 years per year as opposed to $+0.1$ years per year before. Under this assumption the rate of growth of capital stock also would differ slightly, rising from 11.1 percent per year to 12.4 percent per year in 1950–58 and falling from 9.4 percent per year to 8.6 percent per year in 1958–61.

output? The data in Table 2 summarize the results of calculations based on the statistics presented above and, for the postwar period, on acceptance of the embodiment hypothesis as stated in equation (1). It seems hardly worthwhile, however, to attempt full application of (1) to the data on the prewar period. The growth of measured inputs alone more than suffices to explain growth in output. If increases in the quality of capital and declines in its average age made a positive contribution in this period, they were overshadowed and overcome by negative factors. Indeed, it is difficult to analyze farming in the USSR during 1928–37 under the assumption, implicit in the vintage model, that we are studying the behavior of human beings engaged in the "ordinary business of life." As is well known, they were instead in the throes of collectivization and turmoil the extent of which probably no one, including those in the top echelons of the Soviet government, has even a remotely reliable measure.[11]

Table 2. Sources of growth in Soviet agricultural output[a]

Source	Period									
	1928–37	1953–57	1957–62	1953–62	1928–62	1928–37	1953–57	1957–62	1953–62	1928–62
	percentage points					percent of growth rate				
Labor[b]	0.06	1.11	0	0.50	0.33	3	15	0	9	14
Fixed capital	0.77	0.94	0.84	0.89	0.61	40	12	22	16	25
Livestock	−0.29	0.14	0.30	0.22	0.02	−15	2	8	4	1
Land	0.44	1.18	0.48	0.79	0.42	23	16	13	14	18
Current purchases	1.59	0.43	0.59	0.52	0.75	84	6	16	9	31
Total measured inputs	2.57	3.78	2.21	2.90	2.12	135	50	58	53	88
Quality of fixed capital	—	2.31	1.57	2.03	—	—	30	44	37	—
Changes in age of fixed capital	—	1.51	−0.08	0.57	—	—	20	−2	10	—
Total residual	−0.67	3.82	1.59	2.60	0.28	−35	50	42	47	12
Output	1.90	7.60	3.80	5.50	2.40	100	100	100	100	100

[a] Computed from data presented in Table 1 accepting the embodiment hypothesis as formulated in approximation (1). Data may not sum exactly to totals because of rounding.

[b] A preliminary investigation suggests that, in terms of contributions to output as assessed within the framework provided by equation (1), educational capital might have contributed something on the order of less than 0.5 percentage point to growth of agricultural output in the decade of the 1950's. Evidence on levels of educational attainment from [28, p. 17; 29, pp. 78–79 and 123] and associated costs from [6, p. 78], taken together, suggest that as of January 15, 1959, educational capital per man may have been on the order of 1/2 the level for the economy as a whole. On the other hand, inspection of evidence on the comparative progress in educational attainments from [7, p. 809] and [29, pp. 88 and 116] suggests, though not conclusively, that cumulative costs of formal schooling per man may have been growing faster in the agricultural sector. All told, it seems safe to assume that a more extensive calculation will not result in an estimated percentage point contribution vastly different from those computed for the economy as a whole (0.39 in 1950–58 and 0.25 in 1958–61) [2, p. 309]. Thus, a substantial modification of the general conclusions of this paper probably will not be required on this account.

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[11] Some feeling for the extent of the chaos may be gained from diverse sources. Donald Treadgold [27, p. 272] asserts that at least five million peasants died in the process of collectivization and the resultant famine in 1932–33, and he reports that Stalin revealed to Churchill at Yalta that the figure was really ten million. Robert W. Campbell [5, p. 24] states that "some five million persons were deported or shot." According to Leonard E. Hubbard [15], as many as five million *families* may have been deported to Siberia or the Far North. To maintain perspective, we must recall that the agricultural labor force in 1928 was on the order of thirty-three to thirty-four million [22, p. 365].

Under the circumstances, an inspection of the annual changes in our data, shown in Table 3, may prove useful. It would seem that the impediments to growth were concentrated in the early plan period, when, in addition to the chaos, and doubtlessly in large part as a result of it, labor and livestock inputs suffered four successive and substantial declines in 1929 through 1932. These were offset to some extent by steadily, and apparently notably, rising inputs of fixed capital and land. But the upshot appears to have been a persistent contraction in output. Only in 1933, with the restoration of growth in labor input, was the trend reversed and recovery under way. Presumably growth of aggregate output would again outpace that of combined inputs during 1932–37, but this was a period heavily affected by recovery from the depths of the collectivization crisis. Output had not reattained the 1928 level on a sustained basis even by the latter 1930's.

Table 3. Agricultural output and inputs, 1928–37[a]

Year	Output[b]	Labor	Fixed capital	Livestock	Land
	annual percentage change				
1929	− 6.7	− 2.7	8.0	− 1.5	4.4
1930	− 5.4	− 9.1	5.7	−15.4	7.8
1931	− 8.7	− 5.7	7.9	−22.5	7.2
1932	−10.5	− 5.7	9.6	−22.5	−1.4
1933	9.6	10.2	6.7	−17.0	−3.5
1934	6.2	8.2	8.6	3.0	1.4
1935	17.6	10.7	8.7	17.9	1.0
1936	−10.1	− 7.1	10.2	27.2	0.8
1937	22.2	4.3	12.0	1.6	1.1
Period	average annual rate of change				
1928–32	− 7.8	− 5.8	7.8	−15.9	−4.4
1932–37	6.5[c]	5.0	9.4	5.4	0.1

[a] Unless otherwise noted, data were computed from the sources given in Appendix Table A.1.

[b] Statistics on output are in 1937 prices and are from [22, p. 622].

[c] Based on a three-year average centered on 1937 for the terminal year.

World War II also brought such turmoil, disruption, and displacement that again strict application of our model would seem to bear little promise for fruitful empirical implementation. But it was otherwise after the war. By comparison with most of the preceding Soviet period, the years following 1950 were clearly more amenable to interpretation under a rigorous model rooted in the assumption of normalcy.

In this period, sizable residuals did appear, something on the order of 50 percent of the growth rate of output being unexplained by growth of measured inputs. Thus, in 1953–62, the average growth of output amounted to 5.5 percent a year compared with only 2.9 percent a year anticipated from considering measured inputs alone. Under the carrier hypothesis, the remaining 2.6 percentage points may be distributed between two factors: (1) the declining average age of capital, 0.6 percentage point; and (2) the quality of fixed capital, including the net impact of all unspecified variables, 2.0 percentage points.[12] Thus, it would appear that a substantial part of the residual, over 20 percent in 1953–62, was the contribution of a rapid and once-and-for-all reduction in the average age of capital. Since even a significant acceleration of growth in capital stock probably would not induce much of a further decline in its average age,[13] any future rapid advance of factor productivity similar to that of the 1950's could not draw on this source.[14]

While this interpretation has some appeal, consideration of sub-periods within 1953–62 reveals that it may have been a variable unspecified in our strict vintage model, economic policy, rather than improved capital design that was most influential in stimulating growth of productivity. As a matter of fact, agriculture was still the subject of substantial controversy and change after World War II. Commotion and confusion were far from completely absent, and there was no simple orderly feeding of inputs into the farm sector with easily predictable results. Conclusions gleaned from a rigorous analysis again must be tempered by taking some account of other changes in the environment.

Virtually every account of Soviet agricultural performance contributes to the impression that, besides the drive for collectivization in the early 1930's, there were interspersed throughout the entire plan period many shifts in policy and environment with possibly notable consequences for productivity. It may be useful to recall here that there have been changes in: commodity prices, prices of inputs, tax and procurement procedures, pressure to change the size of private plots and private holdings of livestock, the age-sex composition of the labor force, size of the collective and/or state farms, importance of state farms relative to collectives, the internal organization of state and collective farms, planning procedures and autonomy of the collectives, credit policy, labor input norms for the socialized sector (in effect setting maximum time permitted on the private plots), the basis for sales of feed grains and concentrates to households, the differentiation of procurement quotas by region, the official attitude toward and setting of conditions surrounding operation of collective farm markets, and so

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[12] The contributions of the declining $\bar{a}$ and the quality of fixed capital are computed as $d\lambda(-\Delta\bar{a})/1+\lambda(-\Delta\bar{a})$, and $d\lambda$, respectively.

[13] See [4] for a discussion of the relationship between the rate of growth of a capital stock and its age.

[14] Students of the Soviet economy generally seem to agree that other sources, including economic policy changes, could substantially affect productivity as usually measured. David Granick [12, p. 256] has argued effectively that organizational change may have had a marked impact on productivity in the Soviet economy.

That such changes could have considerable quantitative significance may be seen from measured advances in procurement prices and real wages of collective farmers:

Indicator[a]	Average annual rate of growth	
	1953–58	1958–61
Procurement prices[b]	13.9	1.0
Real wages[c]	13.5	4.7

[a] See sources for details on definition.
[b] [24].
[c] [25, p. 97].

In other words, collective farmers' real wages almost doubled within a five-year period and continued to grow at the seemingly acceptable pace of almost five percent per annum for several subsequent years. The fact that the initial values in 1953 were abysmally low, even by Soviet standards, may not completely vitiate the effect on incentives. Lazar Volin [33] suggests that a response was clear in the rapid rise in the number of days worked per man on the collective farms, although he also cautions against concluding that there occurred "anything like a corresponding rise in the efficiency of labor."

Regarding the period since 1958, there has been less unanimity among Western scholars who have in some cases reached rather differing conclusions indeed. Compare for example, the interpretation by Durgin [10] with that by Karcz [19]. Durgin views the period from 1952 to 1962 as an essentially uninterrupted march, even if at a fitful pace, toward "monetization" and eventually "free sales," albeit with a state monopoly on one side of the market. Karcz also perceives clear progress in 1953–57 but retrogression thereafter until the installation of the new leadership in 1964. Diamond [8], though less emphatic, similarly stresses retrogression and confusion from continual administrative reshuffle. The extreme diversity of opinion on this period may be seen by comparing the treatments of various scholars regarding the abolition of the machine-tractor stations.

Bearing in mind the above discussion, the results of implementing the rigorous vintage model with data from the subperiods within 1953–62 are of special interest.[17] The decline in average age of fixed capital (see Appendix

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[17] When dealing with such short periods, the question of possible lags in effects may take on added significance. As the quality of capital improves it may take some time for the farms to "strike their gait" with the new equipment because of the necessity to "learn by doing." This might be of particular importance in agriculture where many operations are performed essentially but once a year. Learning how best to utilize new equipment may take several seasons, whereas in manufacturing the learning process may be compressed into shorter calendar periods. If so, the impact of rapid capital growth and decline in average age may have spilled over into our second subperiod. Normally, one might hope to apply the carrier hypothe-

Table A.2) was concentrated in 1953–57. According to the carrier hypothesis, the growth of factor productivity should be comparatively large in this period, especially since $\bar{a}$ seems to have risen in 1957–62. Inspection of the data in Table 2 indicates that such was indeed the case; growth of factor productivity in 1953–57 was more than double that in 1957–62. Furthermore, it seems that in the first period 40 percent of the residual may have been accounted for by the declining $\bar{a}$. Perhaps even more interesting is the implication that the smaller residual in 1957–62 may be due partially to the *drag* of a rising $\bar{a}$. It seems that despite the essentially sustained contribution from the improving quality of capital, the residual fell because of the rise in average age. On the basis of the evidence presented here, the fall in the growth rate in the second period did stem largely from a reduced growth of inputs, but superimposed on this was the further drag from aging of the fixed capital stock.

In sum, if we abstract from information on economic policy and look at the data for 1953–62, an interpretation based on acceptance of the embodiment hypothesis appears reasonably plausible. If we turn to the subperiods, the predictions of the hypothesis also seem to be consistent with the data. On the other hand, we have practically unanimous expert testimony to the effect that there are other variables, which, though less easily quantified, constitute alternative plausible explanations of the surge in factor productivity in the mid-1950's and of its subsequent ebb.[18] For the period 1953–57, in particular, there is available an impressive body of opinion suggesting that improved government policy could have dominated, and therefore estimates of $d\lambda$ and of $d\lambda(-\Delta\bar{a})/1+\lambda(-\Delta\bar{a})$ under the unmodified vintage model seem clearly subject to upward bias. For this period we have reason, *a fortiori*, for regarding the estimates as an upper limit; but the evidence on the net effect of unspecified organizational factors in 1957–62 seems inconclusive, and, from Karcz's viewpoint, our measures of $d\lambda$ could understate the "truth." There is, however, still another, wider perspective from which to look at the matter.

Disaggregation and analysis of the separate sectors, the nonagricultural nonresidential in [3] and the agricultural here, gives results, which, when focussing on the longer subperiods, further support the carrier hypothesis. In each of the two subsectors, it seems that rather spectacular spurts in productivity came, as the hypothesis would predict, during periods when

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sis to a period of intermediate range, so that errors from ignoring short-term lagged relationships and measurement error would be small.

We must also remember that the concentration of the decline in the average age of capital in the first subperiod may overstate the "truth" (see footnote 10).

[18] Examination of statistics for another period raises further doubts. During 1949–54 the average annual decline in $\bar{a}$ was even greater, specifically, 1.23 years per year compared with −0.78 years per year in 1953–57. Adjusting partially for the effects of weather by taking three-year averages for output and comparing growth of combined inputs with growth in output one finds, nevertheless, a slightly negative residual for this period.

the age of fixed capital was dropping at rapid rates. In the nonagricultural nonresidential sector, it was during 1928–37 that factor productivity contributed 7.3 percentage points to a 16.2 percentage point growth rate. And of this 7.3 percentage points, 2.8 seem to have resulted from the very rapid decline in the age of fixed capital. In this sector in 1950–58, declines in average age, which by then were much less pronounced, contributed only 0.5 percentage point to a much reduced residual of only 3.6. In agriculture, as we have just seen, it was in the postwar period that the age of capital fell precipitously, and factor productivity, apparently boosted in part thereby, underwent an extraordinarily rapid rise.

In conclusion, the embodiment hypothesis certainly does not constitute the final word on sources of Soviet agricultural growth. Indeed the results of a further investigation focusing on equipment as the most likely carrier of technology (see Appendix B) raises serious doubts. We may eventually find that other models[19] will provide more appealing interpretations of the observations. On the other hand it is interesting to note the broad similarity in the results of this study with those on the Israeli *kibbutzim*. For the present, we suggest with some confidence that the vintage model of production does contribute some insight into Soviet agricultural growth and will continue to deserve attention.

Appendix A—The Data

The data underlying the analysis are presented in Appendix Tables A.1 and A.2. Summary descriptions of the data and/or the methods used in its compilation, along with references to the literature containing more detail, are provided in notes to the tables.

Reliability of data on capital

Seriously questioning the reliability of their data on agricultural capital stock, Moorsteen and Powell [22, p. 85] use it only to suggest how the aggregate capital series might have behaved differently from the nonagricultural sector. Thus, it seems especially appropriate to compare their results with those from previous studies. For a substantial number of overlapping years, clear conceptual differences notwithstanding, their data correspond, in at least some respects, reasonably closely to those used for more extensive analytical purposes by Johnson [18] and especially Diamond [8]. Even after taking note of the conceptual disparities, however, some disturbing numerical divergencies appear.

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[19] Some of them, such as those involving, for example, constant elasticity of substitution other than one, variable elasticity of substitution, nonneutral technical change, and so on, have already been elaborated in some detail.

Appendix Table A.1. Soviet agricultural output and inputs, selected years, 1928–62

Year	Output[a]	Inputs					
		Employment[b]	Fixed capital stock[c]		Livestock[d]	Land[e]	Current purchases[f]
			Structures	Equipment			
	billion rubles	1937 man-years	billion rubles			million hectares	index (1928 = 100)
1928	59.0	33.8	17.8	3.3	48.1	113.0	100
1937	65.1	34.0	32.4	12.3	31.4	135.3	590
1953	81.6	38.5	58.0	29.3	39.1	157.2	1115
1957	109.4	41.6	77.1	53.5	42.7	193.7	1366
1962	131.6	41.7	129.1	76.8	54.2	216.0	1931

[a] The Moorsteen-Powell index of agricultural production begins with data on gross physical output from series compiled by Johnson and Kahan [18], supplemented where necessary by corresponding official information. The physical output series were weighted arithmetically with average realized 1937 prices, and the resulting series was adjusted for net changes in livestock herds.

Sources: [1, p. 52] and [22, pp. 361–2, 621, 625].

[b] The data are adjusted for changes in the number of man-days worked per year but not for the number of hours per day. Officially reported statistics on employment in state and institutional farms, Machine Tractor Stations and Repair Technical Stations, and state agricultural services constitute the basis for estimates. Man-day inputs on collective farms and private plots were estimated by Miss Nancy Nimitz from diverse sources including sample data, and these were converted to man-year equivalents by Moorsteen and Powell based on the days worked per year in large-scale industry. Allowance was made for nonagricultural productive activities of persons engaged principally in agriculture. Thus, the data constitute a sheer physical measure with no adjustment for changes in age, sex, or other indicator of quality.

Sources: [1, p. 26] and [22, p. 365].

[c] The statistics on agricultural fixed capital stock were obtained as the difference between the Moorsteen-Powell series on the total and nonagricultural capital stocks. The data reflect initial stocks of structures and equipment as of January 1, 1928, as estimated in [22, p. 49] from information in a document of the Soviet State Planning Commission. For subsequent years, stocks as of January 1 were computed by adding gross investment and deducting retirements.

Investment in structures was obtained by applying Soviet current price data on the distribution of investment between agricultural and nonagricultural structures to the figures for total construction. The estimated stocks of agricultural structures consist of items used directly in production, including, for example, irrigation works, but excluding residences and cultural or industrial capital located on the farms.

The equipment component reflects stocks and flows of "agricultural machines, tractors, trucks, and other means of transport (for example, horse drawn vehicles)." For 1928–35 and 1956, investment data in current prices are deflated to 1937 values. For intervening years, investment was interpolated on deliveries to the farms where possible and on production elsewhere. For the years following 1956, estimates were made by extrapolation on an official series. In general, it may be said that the data provide a splendid example of the incredibly complex detective work based on extremely diverse bits of evidence that have been necessary to form a Western picture of Soviet economic "reality." Moorsteen and Powell provide an admirably detailed presentation of their sources and procedures in [1, pp. 11–12] and [22, pp. 49–50, 84–87, 427–42].

[d] Data are from [1, p. 16] and [22, p. 337]. The authors [22, p. 102] provide the following description: "The value of capital in livestock is calculated from stocks measured in physical units . . . and from average realized prices. . . . The estimates take account of changes over time in the average weight of animals in the herds but not of other qualitative changes such as in age or breed. They include cows, other cattle, hogs, sheep, goats, and horses, but omit rabbits, fowl, bees, camels, mules, buffaloes, and the like."

[e] Information on land includes sown area, omitting fallow and pasture.

Sources: [1, p. 27] and [22, p. 250].

[f] For the period since 1950 the index in [8] was used. It includes fertilizer, electric power, fuels and lubricants, current repair services, and industrially processed feedstuffs. For overlapping years, it shows very close correspondence with the index based on fertilizer and petroleum products from [18]. The latter index has been used for the period

Appendix Table A.2. Average age of Soviet agricultural fixed capital, January 1, indicated years[a]

Year	Average age		Year	Average age	
	Equipment	Total fixed capital		Equipment	Total fixed capital
	years			years	
1928	3.01	12.16	1946	7.25	15.15
1929	3.49	12.23	1947	6.83	15.45
1930	3.73	12.38	1948	5.83	15.47
1931	3.49	12.29	1949	4.45	15.07
1932	3.17	12.04	1950	3.08	14.11
1933	3.07	12.10	1951	2.52	12.34
1934	2.84	11.84	1952	2.48	10.89
1935	2.74	11.65	1953	2.69	9.79
1936	2.62	11.37	1954	2.92	8.92
1937	2.69	10.96	1955	3.19	8.11
1938	3.12	10.75	1956	3.37	7.30
1939	3.62	10.81	1957	3.50	6.66
1940	4.32	10.97	1958	3.56	6.62
1941	4.69	11.25	1959	3.52	6.58
1942	5.00	11.81	1960	3.61	6.69
1943	5.85	12.71	1961	3.80	6.89
1944	6.60	13.63	1962	3.92	7.08
1945	7.11	14.45			

[a] Ages for items in the capital stock as of January 1, 1928 [22, p. 50] were averaged using gross value weights. Year-to-year changes reflect the dates and gross values of subsequent investment and retirements. See also [22, pp. 96ff].

In the following tabulation Johnson's preliminary estimates of agricultural capital services (primarily machinery and draft animals) are presented along with data of approximately like scope from Moorsteen and Powell:

Period	Average annual rate of growth	
	Capital stock (1955 prices)	Capital stock[a] (1950 prices)
1928–38	−0.3	3.5
1938–50	−0.2	− 2.3
1950–55	9.2	21.0
1955–59	5.8	12.6

[a] Includes machinery and horses [22, pp. 105, 107, 325, 328].

Even after allowing for differences in scope (Johnson's data presumably include: (1) some items other than machinery; and (2) draft animals other than horses), in price weights, and in concept (capital services as opposed to capital stock), the disparities seem pronounced to say the least. Johnson's data show for practical purposes no change between 1928–38 and 1938–50, while those of Moorsteen and Powell show a swing from decidedly positive to negative. For the postwar periods the growth rates implied by the Moorsteen-Powell data are more than double those presented by Johnson. On the other hand, the orders of magnitude for 1928–50 are similar. Furthermore, both computations agree that there was a general and exceptional acceleration after World War II and that there was a marked deceleration in 1955–59 as compared with 1950–55.

Compare also, however, the rates of growth of capital stock, the concept used in this paper (implied by the data of Moorsteen and Powell), with those published by Diamond, who uses basically the Soviet official statistics on capital stock and investment:

Average rate of growth of Soviet agricultural fixed capital

Period	Diamond	Implications of Moorsteen Powell in prices of:	
		1937	1950
1950–58	11.2	11.1	10.9
1958–62	10.0	6.2	8.9

The correspondence is all the more remarkable in view of the obvious differences in the underlying data. Diamond's estimates are in 1955 prices. They include draft animals, and they refer to midyear values. Although he depends essentially on the official Soviet figures, he also reports checking his published estimate against an independently constructed index of machinery stocks and agricultural structures, finding only an approximately five percent difference from the official index in 1962 (starting with both equal to 100 in 1928).

Another indicator of reasonable reliability is the behavior of the annual data. As may be seen in Figure 1, the growth rates for each of the twelve overlapping postwar years compare closely in order of magnitude and show a tendency to a similar pattern of change—decline in the early 1950's, resurgence in the middle 1950's, followed by another decline in the late 1950's and early 1960's.

On balance, it will be well to remember that when the archives open and a more reliable index of capital inputs into Soviet agriculture may be constructed, further adjustments probably will be necessary. In the meantime the Moorsteen and Powell data present several advantages: (1) annual measures over lengthy spans; (2) consistency with other variables; and (3) above all, detail on compilation and description of procedures with the consequent possibility for calculating average age. Furthermore, the similarity of at least some of the independent measures for the postwar period may inspire some confidence in the reliability of the numerical values for the later period at least.

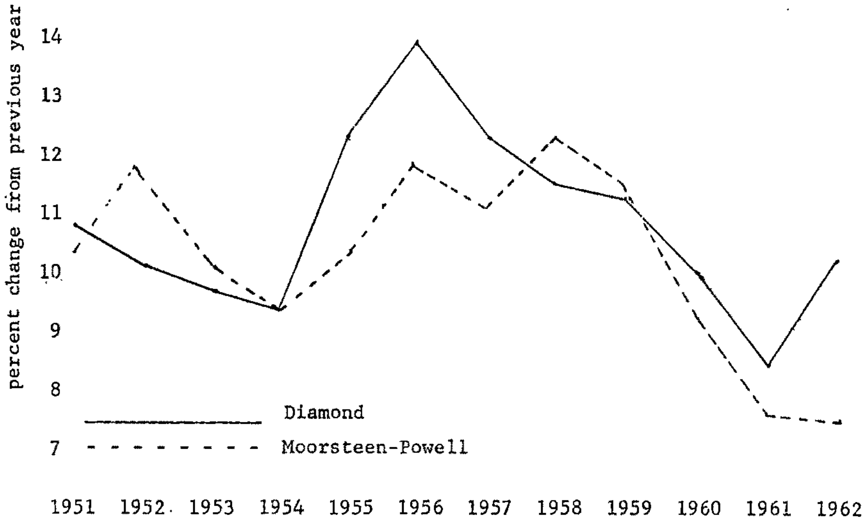

Figure 1. **Annual percent change in Soviet agricultural fixed capital, 1951–62**

Appendix B—An Alternative Hypothesis: Equipment as Sole Carrier

Aggregate analyses involving the embodiment hypothesis generally have employed a comprehensive concept of capital, including equipment and structures. A plausible refinement suggests that we focus on equipment alone, since it appears likely to be especially effective as a carrier of new technology. Some feeling for the importance of technical advance embodied in agricultural machinery may be gained by examining the data presented in Table B.1. on mechanization of some major Soviet farm activities. It would seem that, even after allowing for the fact that data in the official statistical handbooks may be selected to create a favorable impression, the real gains probably were substantial. The apparently great strides forward in mechanization during the 1950's would seem to support the notion that technology carried by equipment may well have been important, if not predominant, in advancing factor productivity.

Then, too, it was during the early to mid-or-latter 1950's, when the first important growth in factor productivity appeared, that the composition of Soviet agricultural capital stock altered drastically, and again probably unprecedentedly, in favor of equipment (from 25 percent of the total in 1950 to almost 70 percent in 1957). Thus a preliminary inspection of some relevant data tends to increase confidence in the possible usefulness of the alternative hypothesis.

This is not to say that structures do not carry new technology or that

Appendix Table B.1. Mechanization of selected productive activities on Soviet collective and state farms[a]

Activity	Year				
	1945	1950	1955[b]	1960	1964
	percent of total				
Sowing					
grain	39	75	94	100	100
cotton	71	92	99	100	100
sugar beets	75	92	96	100	100
potatoes	0.8	6	51	58	69
Harvesting					
grain	27	53	81	92	97
sugar beets	—	2[b]	30	86	85
cotton	71	92	N.A.	100	100
potatoes	N.A.	3[b]	18	72	83
hay	8	24	49	68	76

[a] Unless otherwise noted, data are from [32, pp. 158–159].

[b] Based on data in [30, p. 143] covering collective farms only and therefore probably subject to downward bias. Data for 1965 [31, p. 400] suggest that collectives generally lagged somewhat behind the state farms in their level of mechanization.

they might not be necessary complements to machines, constituting therefore an essentially indivisible package in which society must invest in order to obtain the benefits of the new techniques more clearly carried by equipment. Electric power lines, for example, though structures, may embody new technology in the sense of more effectively transmitting electricity. They are also clearly essential to the operation of certain pieces of equipment installed on the farm. In fact, one may wish to view them, though nominally structures, as an essentially integral part of the equipment actually in use on the farm.

Normally one would expect, however, that the rate of improvement in structures per se would be far less than the average for all fixed capital. Suppose we examine the possibilities for employing the alternative hypothesis to interpret the evidence on Soviet agricultural development. We shall see that a strict extension of the analysis in the text raises further doubts about the usefulness of the carrier hypothesis.

In the first place, the 1937 weight for fixed capital, including structures, is only 0.0886; equipment in turn accounted for less than 30 percent of agricultural gross capital stock. The embodiment hypothesis thus puts the burden for carrying technology (and explaining an occasionally large residual) on a productive agent whose own weight in the national income is quite small. In those cases where $\Delta A/A$ is substantial, the rate of improvement in the quality of equipment (λ_q) will have to be rather large.[20]

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[20] Ezra Sadan's study of embodied technology in Israeli cooperative farms [26, p. 975] found by regression a similarly low value (0.03) for the partial elasticity of output with respect to inputs of equipment (defined as items with service life of ten years or less).

Furthermore, there are complications suggested by the alternative interpretation due to the extremely uneven changes in the stock of agricultural equipment and consequently in its gross value weighted average age, (a_q). The decline during World War II and the recovery in the period immediately following were much more pronounced in stocks of agricultural equipment than in structures. There were substantial successive reductions in each year, 1942 through 1947. Although some of the decline apparently did represent retirement of aged, wornout items, it also reflected the low levels, and in some years utter lack of gross investment during the war. The upshot was that a_q seems to have reached over 7 years by the end of 1945, i.e., a level not quite 3 times as high as the prewar minimum computed for January 1, 1936.

Under these conditions, a return to more nearly normal growth of investment had the inevitable numerical consequence that values for a_q fell rather rapidly. By the early postwar period, retirements of equipment acquired in the latter 1930's were becoming substantial, and their impact on a_q was especially apparent, so that it began to decline even before growth in the stock of equipment reappeared. As reconstruction progressed, annual investment in equipment became very large relative to existing stocks; and the growth of the equipment stock ($\Delta K_q/K_q$) accelerated to clearly unsustainable rates, capped by an extremely atypical 98.8 percent spurt in the two years 1950–51 with successive rises of 36 and 46 percent, respectively. In the subsequent years the growth rate necessarily ebbed rapidly.

The movement of a_q (see Appendix Table A.2) reflects, of course, these diverse currents. There was a spectacular descent from 7.2 years at the end of 1945 to 2.5 year by the end of 1950. When $\Delta K_q/K_q$ receded to more nearly normal levels, though remaining probably still quite high by many standards, a_q actually began to rise through the remainder of the 1950's.

Strictly speaking then, the alternative hypothesis would predict a boost to productivity in the early postwar period, followed by a drag throughout the 1950's. Suppose that we were to choose the periods 1947–50 and 1953–57 on the basis of substantial variation in the variable of primary interest in the vintage interpretation, a_q. What values would be obtained for λ_q and $d'\lambda_q(-\Delta a_q)/1+(\lambda_q)(-\Delta a_q)$?[21] The outcome in this case is the reverse of expectations based on the carrier hypothesis. Specifically, in 1947–50 all measured inputs grew faster than output, so that regardless of the weights, or the elasticity of substitution for that matter, no residual remains to be explained. Furthermore, one might suspect that during this period of reconversion and reconstruction the average quality of the labor force improved considerably and that restoration of idle machinery contributed importantly to restoration of output. These factors, along with the rapid reduction in a_q under a strict implementation of the carrier hypothesis,

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[21] The prime on d denotes that the weight refers to equipment alone.

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Characteristics and Salaries of Agricultural Economists*

EMANUEL MELICHAR

Employment and salary characteristics for agricultural economists as of 1966 differ from those of general economists and other scientists in several respects. Educational institutions employed 58 percent of agricultural economists as against 45 percent of economists generally and 36 percent of all scientists. Only 9 percent were employed by business and industry as compared with a third of all economists and 41 percent of all scientists. The geometric mean basic salary received by agricultural economists was $13,000 as compared with $13,600 for all economists and $12,100 for all scientists. Academic degree attained and length of service have a greater influence on salary variation than age, type of employer, or primary work activity.

THE NATIONAL SCIENCE FOUNDATION has biennially since 1956 compiled a "National Register of Scientific and Technical Personnel" to provide statistical information on the supply, utilization, and characteristics of the nation's scientists. Economists were first included in the 1964 register, at which time agricultural economists were grouped with specialists in forestry and fishery economics to form a subclass of land economists. In 1966, however, agricultural economics was identified as a separate specialty and 1,204 individuals, 9.2 percent of all economists responding, indicated it as the area in which they had greatest scientific competence.

In addition to their professional field and specialty, registrants reported salaries, professional incomes, and characteristics such as age, sex, highest academic degree, length of experience, type of employer, and primary work activity. After the 1964 and 1966 surveys, the American Economic Association published distributions of all registered economists by these characteristics, as well as analyses that attempted to isolate and quantify the influence of each characteristic on salaries received [1, 3]. Similar data and analyses are here presented for agricultural economists in the 1966 register. Insofar as possible, comparable data for all economists and all scientists are also shown.

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* The cooperation of Milton Levine, Study Director, and J. James Brown, Associate Study Director of the National Register Group of the National Science Foundation is gratefully acknowledged. This article supplements the more general study of economists in which the author participated. See [3].

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Characteristics of the Profession

The NSF attempts to secure a report from every individual in each field of science covered by the National Register. It fails to reach such ultimate perfection, of course—first, because it probably does not get a questionnaire to every eligible individual, and second, because some individuals do not return their questionnaires. Thus, for the data that follow, neither universe coverage nor scientific sampling can be claimed; however, a representative group of agricultural economists appears to have responded, undoubtedly due in large part to use of the AAEA membership list.[1]

As a group, agricultural economists exhibited a relatively high level of formal training. Nearly three-fifths had a Ph.D. degree, compared with fewer than one-half of all economists (Table 1). Most of the remaining agricultural economists had received a Master's degree, whereas 21 percent of all economists and 29 percent of all scientists had only the Bachelor's degree.

Distributions of agricultural economists by age and length of experience resembled those of all economists and all scientists. Although a noticeably smaller proportion was under 30, this difference appears related to the finding that most agricultural economists obtain higher degrees and thus enter the profession at a more advanced age.

It is hardly news that most agricultural economists are employed by universities and the federal government, but still interesting to compare the relative proportions with those for other professions. Educational institutions employed 58 percent of agricultural economists, as against 45 percent of economists generally and 36 percent of all scientists. One-fourth worked for the federal government, about double the proportion among the other groups. Only 9 percent were employed by business and industry, compared with a third of all economists and 41 percent of all scientists.

Primary work activities most frequently reported by agricultural economists were research, management, and teaching, in that order. Forty percent listed research—mostly applied research—as their primary activity, which was more than twice the percentage among all economists and also slightly higher than the proportion among all scientists. Another 13 percent were engaged primarily in management of research activities, while 14 percent managed other endeavors. Only 18 percent named teaching as

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[1] Distributions cited here have been restricted to persons who reported basic salary. As compared with all registrants, this group may be more representative of working members of the professions because respondents who did not report salary were concentrated among young persons who were likely still in graduate school and older persons who appeared likely to be retired.

Table 1. Distribution of scientists and geometric mean salaries, by selected characteristics, National Register, 1966

Characteristic	Percent of total number reporting salary			Average salary (geometric mean in dollars)		
	Agricultural economists	Economists	All scientists	Agricultural economists	Economists	All scientists
Total	100.0	100.0	100.0	13,000	13,500	12,100
Type of employer:						
Educational institution						
Academic year base	3.6	26.3	17.7	10,400	10,800	9,800
Calendar year base	49.5	14.4	14.6	12,800	13,200	12,000
Base not reported	5.1	3.9	4.1	13,100	11,900	10,900
Government						
Federal	23.9	11.7	12.2	13,300	14,400	12,200
Other	4.0	4.2	4.0	12,900	13,400	10,000
Nonprofit organization	3.2	3.9	4.4	16,000	15,900	12,900
Industry and business	9.3	33.9	40.7	14,200	16,000	13,300
Self-employed	.7	1.0	1.3	9,800	18,100	16,700
Other or not reported	.7	.8	.9	13,000	15,200	11,800
Years of experience:						
1	3.2	2.7	3.1	9,900	9,000	8,000
2–4	13.3	11.6	12.7	9,700	9,300	8,700
5–9	19.7	18.0	21.1	11,300	11,100	10,300
10–14	15.0	15.4	18.1	12,700	13,100	12,400
15–19	17.8	18.0	16.5	14,100	15,100	13,700
20–29	17.4	19.2	16.3	16,300	17,200	15,100
30 and over	11.4	11.5	9.2	16,200	18,100	15,400
Not reported	2.2	3.6	3.0	15,000	14,600	12,500
Highest academic degree:						
Professional medical	—	—	2.5	—	—	16,100
Ph.D.	58.9	45.6	41.5	14,000	14,000	13,300
Master's	34.6	32.1	25.1	11,600	12,300	11,000
Bachelor's	6.4	20.6	28.8	12,900	14,900	11,100
Other or not reported	.1	1.7	2.1	6,000	15,900	11,600
Primary work activity:						
Management of:						
R & D	13.4	10.9	23.0	16,300	17,500	15,400
Other than R & D	13.6	20.3		14,900	17,600	
Basic research	5.4	4.8	35.4	11,500	12,500	11,700
Applied research	34.5	13.0		12,000	12,800	
Teaching	18.3	30.4	19.9	12,000	10,800	10,000
Production and inspection	2.7	9.4	7.9	12,100	13,000	10,900
Other or not reported	12.1	11.3	13.8	13,600	14,500	11,900
Age:						
Under 30	7.4	9.6	13.8	9,700	9,100	8,300
30–34	15.3	15.6	17.6	10,000	10,700	10,300
35–39	18.1	17.5	19.2	12,000	12,700	12,100
40–44	17.9	17.0	17.0	13,700	14,700	13,400
45–54	26.3	26.7	22.0	15,000	16,300	14,500
55–64	12.6	11.2	8.8	16,000	17,200	14,800
65 and over	2.2	2.2	1.4	15,600	15,500	13,800
Not reported	.2	.2	.2	12,200	13,800	10,800
Sex:						
Male	99.5	96.4	93.4	13,000	13,700	12,300
Female	.5	3.6	6.6	10,500	10,500	9,100
Agricultural economic specialty:						
Finance and marketing	40.5	—	—	13,200	—	—
Processing of farm products	2.7	—	—	13,000	—	—
Farm management	20.3	—	—	12,500	—	—
Production economics	21.7	—	—	12,300	—	—
Other	14.9	—	—	14,500	—	—

their primary activity, compared with 30 percent of all economists. "Extension" was not listed on the questionnaire.

In the 1966 survey, agricultural economists were offered a choice of four specialties—finance and marketing (chosen by 40 percent), farm management (20 percent), production economics (22 percent) and processing of farm products (3 percent). The NSF appears to have been poorly advised in formulating these groupings. An improved selection of specialties has since been offered in the 1968 survey: demand and supply analysis, situation and outlook, policy, finance, marketing, farm management, and land reform.

Salaries

The geometric mean basic salary received by agricultural economists in 1966 was $13,000—somewhat below the mean of $13,600 for all economists but considerably above that of $12,100 for all scientists.[2] Direct comparison of these averages may be misleading, however. For instance, most agricultural economists employed by educational institutions worked for a full calendar year, whereas most other university economists reported a basic salary covering only an academic year of 9 to 10 months. Or, as already noted, agricultural economists on average were older and had more advanced degrees—factors that should also tend to increase salaries, other things being equal. Thus a regression analysis of economists' salaries that allowed for the influence of such characteristics revealed that specialization in agricultural economics was associated with slightly greater salary disadvantage than indicated by gross salary averages. Along with specialists in economic history and land economics, agricultural economists were found at the lower end of the pay range—tending to have basic salaries 5.7 percent below the average for all economists and about 10 percent below those paid to persons in specialties at the top of the range—monetary and fiscal theory and international economics [3, pp. 76–77].[3]

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[2] The NSF has always used salary medians rather than other averages in its National Register publications—a sound practice in that medians are less affected by extreme values [4]. However, because salary medians were not available for many classes used in this paper except at prohibitive cost, geometric means (means of logarithms of salaries) were chosen in preference to arithmetic means because the geometric means are also less affected by extreme values and because their use parallels the use of logarithms of salaries in the regression analysis that follows. For comparison, the following were national median, geometric mean, and arithmetic mean salaries, respectively, in agricultural economics: $12,900, $13,000, and $14,000; in economics: $13,100, $13,600, and $15,000; in all fields: $12,000, $12,100, and $13,000.

[3] A comparison in terms of total professional income would probably be still more unfavorable to agricultural economists. Salary supplements received by economists in 1964 were found to be relatively low among (1) academically-employed persons paid a calendar-year basic salary and (2) persons employed by the federal government [3, pp. xxix-xxxv]. Three-fourths of all agricultural economists belonged to one or the other of these groups in 1966.

In an interesting parallel, agricultural scientists had one of the lower salary medians among all professions, 17 percent below that for all scientists, whereas the median for economists was 9 percent above that figure. When salary was regressed on professional characteristics, specialization in economics continued to show a net positive influence on salary—second only to that exerted by mathematics—while specialization in the agricultural sciences had by far the most adverse influence on salaries among the 13 fields covered. Net regression coefficients indicated that salaries of agricul-

Intra-profession differences in average salaries among classes such as employer and age groups may also be misleading because of intercorrelations. For example, economists with more experience, or higher degrees, or management responsibilities tend to be paid more; but these characteristics are often associated. How much of the higher pay, therefore, can be attributed to each characteristic—e.g., how much of the higher salary of older economists is a reward for their added experience rather than for their generally higher degrees or the management responsibilities they have assumed?

To separate and quantify intercorrelated effects, multiple regression analysis is indicated. Thus, for agricultural economists, salary (in logarithmic form) was regressed upon the six major characteristics listed in Table 1 (sex was omitted). The logarithm of salary was used as the dependent variable, so that the net influence of each characteristic would be measured in proportional rather than absolute terms, with the cumulative effect of all characteristics multiplicative rather than additive. A dummy variable was used to represent each class of each discrete characteristic and each class interval of the age and experience characteristics, in the latter case permitting anticipated nonlinear effects to be picked up [2]. A two-way interaction expected between type of employer and length of experience was represented in the regression model by providing a separate set of dummy variables to represent length of experience for each of the three major employer groups—educational institutions, government, and other (primarily industry and business). Similar regression models were also estimated for all economists and all scientists.

Relative net influence of characteristics

The relative contribution of each characteristic toward explanation of salary variation is indicated by the coefficients of partial determination listed in Table 2.

The academic degree attained by the respondent exerted the greatest net influence on salary, not only among agricultural economists but also among all economists and all scientists. Length of experience likewise explained a relatively high proportion of salary variation among agricultural economists, whereas the type of employer and the primary work activity had less effect. Age was relatively unimportant after experience and degree were taken into account. The agricultural economic specialty, as specified in the 1966 questionnaire, proved least important in explaining total salary variation, though it was just significant at the .05 probability level. Similarly, the specialty within economics was relatively unimportant in this respect, though as already noted a substantial salary difference was

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tural scientists tended to be 21 percent below those of economists and 16 percent below the average for all scientists [3, pp. 66–68].

Table 2. Importance of selected characteristics in explaining salary variation, National Register, 1966

Characteristic	Importance of net relationship (partial R^2)		
	Agricultural economists	Economists	All scientists
Years of experience and type of employer	.132	.130	.149
Years of experience (separately for each major employer group)	.091	.068	.054
Type of employer	.056	.020	.041
Highest academic degree	.105	.076	.159
Primary work activity	.043	.051	.065
Age	.022	.011	.019
Sex	—	.016	.024
Agricultural economic specialty	.011*	—	—
Economic specialty	—	.008	—
Profession	—	—	.066
Multiple R^2	.41	.49	.54

* Significant at the .05 probability level. All other relationships are significant at the .01 probability level.

found between the specialties at the high and low extremes of the salary range. Among all scientists, the field of work did exert considerable net salary influence.

Net relationships

Net relationships between salary and the various characteristics are quantified by regression coefficients and presented in Table 3 as net percentage differences from the geometric mean salary of each of the three professional groups. For agricultural economists, the net relationships that emerged from the regression of salary on all six characteristics simultaneously (column 2) may be compared with gross relationships (column 1) computed from actual geometric salary means (or obtained by regression on only the characteristic concerned)

Experience and employer.—For agricultural economists with each major employer, the net progression of salary with added experience was less marked than gross salary averages might have led one to suppose, as some of the progression is ascribed to attainment of higher degrees, movement into management positions, and advance in age.

At the beginning of their career, agricultural economists employed by business appeared to be at a salary disadvantage compared to their counterparts in government and universities. Such early disadvantage in business employment was not found among all economists or all scientists. At the other end of the experience range, however, all three professional groups obtained higher salaries from business than from other employers.

Table 3. Relationships between salary and specified characteristics, National Register, 1966

Characteristic	Percentage difference from national geometric mean salary of respective professional group			
	Gross	Net		
	Agricultural economists	Agricultural economists	Economists	All scientists
	(1)	(2)	(3)	(4)
Years[a] of experience (by selected employer group):				
Educational institution				
1	−20.0	−11.8	−19.4	−28.8
2–4	−23.6	−16.8	−19.7	−23.4
5–9	−13.9	−10.7	−15.5	−16.5
10–14	−7.5	−9.4	−11.8	−7.3
15–19	7.2	−.3	−4.8	−.5
20–29	20.5	12.9	2.7	7.6
30 and over	14.0	10.4	8.2	12.4
Federal government				
1	−23.4	−17.1	−26.3	−26.0
2–4	−25.5	−12.0	−18.7	−15.8
5–9	−15.1	−5.4	−6.3	−5.7
10–14	0	.5	−1.4	.9
15–19	9.1	6.6	8.1	7.2
20–29	26.5	18.6	20.5	16.0
30 and over	32.7	30.3	27.2	24.7
Industry or business				
1	−41.4	−29.7	−15.4	−10.8
2–4	−35.4	−28.4	−15.8	−6.0
5–9	−6.9	2.4	−.9	2.7
10–14	19.4	20.1	12.5	11.5
15–19	10.9	8.9	23.9	20.2
20–29	38.0	45.0	40.4	30.5
30 and over	51.0	44.5	61.5	40.8
Primary work activity:				
Management of:				
R & D	25.0	10.1	11.7	14.9
Other than R & D	14.5	10.6	12.7	
Basic research	−11.7	−8.1	.9	−1.5
Applied research	−8.2	−4.9	−1.5	
Teaching	−8.2	−1.9	−9.1	−9.4
Production and inspection	−6.9	−8.6	−8.4	−5.5
Highest academic degree:				
Ph.D.	7.4	8.7	12.5	15.5
Master's	−11.3	−10.7	−9.3	−8.5
Bachelor's	−.9	−13.5	−10.0	−13.6
Age:				
Under 30	−25.9	−5.6	−11.9	−12.8
30–34	−22.9	−11.5	−6.5	−4.2
35–39	−8.0	−.1	−.1	1.9
40–44	5.4	5.1	3.2	4.7
45–54	15.3	2.1	4.8	5.9
55–64	23.0	6.7	4.1	2.7
65 and over	19.7	−.6	−1.8	−2.8
Agricultural economic specialty:				
Finance and marketing	1.6	.2	—	—
Processing of farm products	−.2	.1	—	—
Farm management	−4.3	−4.6	—	—
Production economics	−5.6	−.1	—	—
Other	11.1	5.8	—	—

[a] Calendar years.

For example, agricultural economists with 30 or more years of experience tended to earn 11 percent more in business than in the federal government and 31 percent more in business than at educational institutions.

For both agricultural economists and all economists, net salary progression with added experience was greatest in business and least at educational institutions. Between the class of agricultural economists with 2 to 4 years of experience and that with 30 or more years, the total net salary gain attributed to added experience was 102 percent in business, 48 percent in government, and 33 percent at colleges. If one assumes that this period covers 30 years, the net average annual rate of such progression was 2.4 percent in business, 1.3 percent in government, and 1.0 percent at colleges. These large differences made interaction terms necessary in the regression analysis; conversely, the differences were picked up in the analysis only because the interaction terms were included. In contrast to the finding for economists, salary progression among all scientists was about the same for all three major employer groups, averaging about 1.5 percent annually.

Highest academic degree.—Among agricultural economists possession of the Ph.D. degree tended to yield a 22 percent net salary advantage over the Master's, a shade less than among all economists and all scientists. The Master's degree carried a negligible advantage over the Bachelor's among both agricultural and all economists, but a more significant advantage among all scientists. The relative salary value of these degrees was thus clarified by the multivariate analysis, for gross salary averages had shown that holders of the Bachelor's degree earn more than persons with the Master's. This perverse gross relationship was found among all three professional groups and was particularly pronounced among economists.

Primary work activity.—Compared with all economists and all scientists, agricultural economists were rewarded slightly less for management duties, substantially less for research, and considerably more for teaching. Teaching exhibited a small salary advantage over research among agricultural economists, whereas research had a large advantage over teaching among both all economists and all scientists. The joint research-teaching appointments commonly used in agricultural economics may be responsible for this difference.

Future Analyses of National Register Data

The preceding structural data and analysis of salary variation for agricultural economists represent only an initial instalment of the flow of information potentially available from the binennial NSF survey of the profession. In addition to updating the cross-sectional view, future studies may profitably employ some of the many additional characteristics about which data are obtained, such as colleges attended or institutions where now employed. The NSF has also arranged its files to permit studies of factors affecting the mobility and progress of individuals after data have been collected over a longer time span.

These potential analyses of the profession of agricultural economics clearly hinge on continued support of the NSF survey through a high and representative level of voluntary response to the NSF questionnaires. As economists, we are more often engaged in surveying others rather than in being surveyed and thus can readily appreciate that high participation rates are needed to provide the degrees of freedom required for more detailed and sophisticated analyses, and that repeated biennial participation is necessary if future longitudinal studies are to be possible. Every member of the profession should take care to fulfill his seemingly small but very vital role in this endeavor.

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Research Notes

Note on the U.S. Demand for Coffee[*]

JOHN J. HUGHES

FOUR postwar estimates of the demand function for coffee in the United States, derived from time series, have given elasticities for income between .22 and .60 [1, 2, 4, 5]. Two of the studies [1, 5] noted that the income elasticities using only postwar data were much smaller than the elasticities from the interwar period, and both suggested plausible reasons for the difference: (1) the changed age distribution of the population in the postwar period, important because coffee drinking is negligible for children and small for teenagers compared with adults; (2) the growth in consumption of instant coffee, which uses less green coffee beans than regular coffee; and (3) a steadily rising extraction rate of instant coffee from a given amount of green beans.

While it is true these factors have worked in the expected direction in the postwar period, they cannot be the major reasons for the reduced income elasticity since it can be shown that, even after correcting for them, the income elasticity is actually negative in the postwar period.

The demand function employed in these studies was $Q = f(Yd, rP)$, where Q is the quantity of green beans consumed annually, Yd is aggregate real disposable income, rP is a weighted average of the prices of regular and instant,[1] deflated by the all-items CPI. Q and Yd are deflated by specific populations.[2]

Estimates of the demand parameters are shown in Table 1 for the best-fitting, linear versions for two periods, 1920–41 and 1947–66,[3] for three populations—total, fourteen years and older, and 20 years and older[4]—and, in the postwar period, for two quantity series—the actual amount of green beans consumed and a "corrected for instant" quantity, identified as Q'.

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[*] The author gratefully acknowledges the data assistance of the Pan American Coffee Bureau.

[1] The weights are estimated cups of regular and instant coffee drunk each year. Price data are from the Bureau of Labor Statistics and Market Research Corporation as reported in [3, pp. A–143–4]; cup consumption of instant coffee estimated by Market Research Corporation of America and Pan American Coffee Bureau [3, p. 129].

[2] Daly [1] and Rhomberg [4] use 14 and over; the FAO [2] and the U.S. Depart-

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Table 1. Demand equations for coffee[a]

Equation[b]	*by*[c]	*Ey*[d]	*brp*[c]	*Erp*[d]	$\bar{R}^2$	*DW*[e]
(1) 1920–41, total population	4.21 (4.65)	.338	−.084 (−7.60	−.302	.758	2.25
(2) 1920–41, 14 and over	3.92 (4.31)	.315	−.104) (−6.88)	−.271	.707	2.38
(3) 1947–66, total population	−5.05 (−7.77)	+.568	−.030 (−3.97)	−.143	.74	1.86
(4) 1947–66, 14 and over	−2.79 (−5.48)	+.315	−.033 (−3.41)	−.113	.59	2.14
(5) 1947–66, 20 and over	−3.03 (−4.48)	+.272	−.050 (−4.65)	−.148	.58	2.23
(6) 1947–66, Q', total population	−2.72 (−3.97)	+.290	−.033 (−4.18)	−.150	.51	2.10
(7) 1947–66, Q', 14 and over	−.731 (−1.19)	+.078	−.039 (−3.31)	−.125	.28	1.84
(8) 1947–66 Q', 20 and over	−.118 (−.143)	−.010	−.058 (−4.43)	−.163	.49	1.87

[a] The variables in all cases were: *Q*, per capita pounds of green beans; *Yd*, per capita disposable income in thousands of 1957–59 dollars; *rP*, the average retail price of coffee in cents per pound deflated by the all-items CPI.

[b] The means of the *Q*s for equations (1) through (8) are: 17.6; 24.1; 16.1; 22.4; 25.6; 17.0; 23.6; 27.0.

[c] *by* and *brp* are the regression coefficients for *Yd* and *rP*. The figure in the parenthesis below the coefficient is the ratio of the coefficient to its standard error or t.

[d] *Ey* and *Erp* are the elasticities of quantity with respect to income and relative price, respectively, evaluated at the means.

[e] *DW* is the Durbin-Watson statistic.

The correction for instant coffee and the increasing efficiency of the extraction rate required conversion of the instant coffee consumed each year into the equivalent number of green beans required for regular [5, pp. 25–26]. An adjustment was made each year for the changing extraction rate [3, p. 124]. The series is thus the sum of green beans used for regular and the green beans that would have been used if the instant coffee consumed had been regular.

The negative sign of the income coefficient in all the postwar equations 3 through 8 contrasts sharply with the significantly positive sign in the in-

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ment of Commerce [5] use total population. Rhomberg deflates the coffee price by the implicit price deflator for non-durable consumer goods.

[3] Calculations were also made for semi-log and log-log function forms.

[4] There are complications with the 20 and over population; while it is the most appropriate deflator for the quantity series, its use in deflating the income series transfers the income earned by those less than 20 to those 20 and older, and, moreover, assumes (as does the 14 and older to a lesser extent) that infants, children and teenagers do not consume economic goods. Equation 8 used the population 20 and over to deflate the quantity series and, as a convenient approximation to the required equivalent adult measure, the population 10 and older as deflator for the disposable income series.

terwar equations 1 and 2 and implies that, as an inferior good, coffee is being displaced by one or more beverages appropriate to higher per capita incomes, such as alcoholic beverages. Adult consumption of wine and distilled spirits has been rising in the postwar period; beer consumption declined slightly from 1947 to 1954 but is now back to the 1947 level.

It is difficult, however, to determine the role of alcoholic beverages in the coffee demand function for two reasons. First, distilled spirits and wine consumption are collinear with disposable income, the simple correlation coefficients being .88 and .93. Regressions substituting distilled spirits and wine consumption for income gave results similar to equation 5: highly significant negative coefficients.

Second, the interwar period as a beverage era is also sharply distinguished from the postwar period by the legal prohibition on alcohol in the twenties and early thirties. The repeal of prohibition came early in the thirties and while the long depression may have driven some to drink, it must have had a sobering influence on many others through the income effect. And, during World War II, there was rationing of liquor. Coffee consumption was thus, perhaps, unsustainably high at its maximum in 1946 because of the suppression of alcohol consumption in one way or another in the previous twenty-five years. The subsequent decline in coffee use may not have been causally related to the growth in per capita income but to the reappearance of a competitive commodity.[5]

These speculations do not affect the point of this note: that if income and relative prices are used to explain coffee consumption, the coefficient sign of the income variable is significantly negative (and remains negative under suggested adjustments). Whether the income variable is measuring very successfully the "income effect" is another question.

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Direct Payments: An Increasing Proportion of Farm Income and a Changing Geographic Distribution*

HAROLD D. GUITHER

AN earlier article [3] reported the distribution of direct government payments per farm and the relation of payments to realized gross and net farm incomes from 1933 to 1964. During the last five years, total direct payment expenditures have more than doubled [10, p. 64; 9]; and the cotton program, added to feed grains and wheat, has realigned the distribution among states, providing a new and more complex dimension for policy makers to resolve.

Payments per farm, as well as payments in relation to realized gross and net income, have also gradually increased (Table 1). In 1968, preliminary data show that payments were $3,485 million [10, p. 6].[1] With payments excluded, this was equal to 7.4 percent of realized gross and 30.7 percent of realized net income. The feed grains, wheat, and cotton programs accounted for 76 percent of all direct payments in 1965, 84 percent in 1966, 77 percent in 1967, and 83 percent in 1968.

Table 1. Average direct program payments per farm and payments as percent of realized gross and net farm income, 1964-68

Year	Payments per farm	Payments as percent[a] of:	
		Realized gross income	Realized net income
	dollars		
1964	634	5.4	19.6
1965	737	5.8	21.0
1966	1,012	7.1	24.8
1967	979	6.7	26.9
1968[b]	1,139	7.4	30.7

[a] Computed with government payments excluded. With payments included, payments as percent of realized gross would be 5.1 in 1964; 5.5 in 1965; 6.6 in 1966; 6.3 in 1967; and 6.9 in 1968. Payments as percent of realized net from 1964 to 1968 would be 16.7, 17.6, 20.2, 21.6, and 23.4, respectively.

[b] Preliminary.

Sources: [9, 10, 11, 12].

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* The author expresses appreciation to R. G. F. Spitze and Earl R. Swanson for reviewing an earlier draft of this paper.

[1] The 1968 preliminary figure reported in [11] was $3,485 million; the total reported in [9] was $3,475 million.

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With the high public interest[2] in direct payments at the present time, it seems appropriate to note the changes occurring and the distribution among the states and to assess the reasons for these changes.

The uptrend in payment per farm from $634 in 1964 to $1,139 in 1968 can be attributed partly to the 11 percent decline in farm numbers (from 3.442 million to 3.054 million) [13], but mainly to the 16 percent rise in payments [11, 12].

The continuous increase in payments as a percent of realized gross income from 1964 to 1968 is due primarily to increased payments, since realized gross income rose each year except 1967. Realized net income declined from the previous year in 1967 and 1968 so that both increased payments and a smaller net have helped to boost the percentage relationship of payments to net income.

In 1968 payments per farm varied among the states from $74 in Rhode Island to $7,322 in Arizona (Table 2).[3] Compared with the 1963 distribution and rank among states in payments per farm [3], the 1968 figures show the impact of the cotton program among the top 15 states. Arizona, New Mexico, Texas, California, and Mississippi moved up to higher rank than they held five years earlier. Rhode Island and other states with low payments outside the feed, wheat, and cotton producing areas, received most of their payments under the Agricultural Conservation Program.

More satisfactory indicators of the importance of change, however, are payments measured as a percent of realized gross and realized net incomes [3, p. 224]. In 1968 payments varied from .3 percent of realized gross income (excluding government payments) in Rhode Island to 19 percent in North Dakota. In terms of realized net income (excluding payments), payments varied from 2 percent in Massachusetts to 113 percent in North Dakota.[4]

Payments under feed grains, cotton, and wheat programs also show wide variations. Under the 1967 feed grain program,[5] payments were

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[2] Some typical public reactions reported in the press and expressed in editorial comment are "Rich Get Richer," *Time* 89:19, June 30, 1967; "It's Time to Turn the Farmers Loose," *Fortune* 74:140–5, Dec. 1966; "A Possible Practical Utopia," by John Fischer, *Harper* 233:16, July 1966; "Farm Follies," *Reporter* 37.16, Sept. 21, 1967; "Findley Raps High Farmer Subsides," Robert A. Hunt, Associated Press story, March 15, 1969.

[3] Grove [3, p. 225] points out the close correlation between average payment per farm and payments measured as a percent of realized gross and realized net income and indicates that the wide variation in payments per farm among the various states is not due primarily to variation in size of farm but reveals a real difference in the incidence of direct payments among the states. However, Arizona, with its very large farms, may be an exception to this general relationship.

[4] Alaska's average payment per farm was $393 and its realized net per farm, including the payments, was $248 [11]; without payments, realized net income would have been a loss of $145. In 1967, payments were equal to 35 percent of net income; in 1966, 16 percent.

[5] 1968 figures not available at the time of writing.

Table 2. Comparisons of direct payments by states

State rank	1968 payments per farm[a]	All payments as percent[b] of:		Commodity program payments—1967[c]		
		Realized gross income	Realized net income	Feed Grains	Wheat	Cotton
	dollars			*percent of value*	*percent of cash marketings*	
1. Arizona	7,322	7.8	36.9	3	21	60
2. North Dakota	3,116	18.4	113.1	7	37	—
3. Montana	2,735	14.7	92.1	4	34	—
4. New Mexico	2,569	10.1	39.7	26	79	51
5. Kansas	2,507	14.1	78.1	20	49	—
6. Nebraska	2,437	10.6	63.2	16	31	—
7. Hawaii	2,395	5.3	14.5	—	—	—
8. Texas	2,387	16.3	84.3	16	55	107
9. Colorado	2,030	6.3	53.0	16	64	—
10. South Dakota	1,830	8.9	32.8	13	31	—
11. Iowa	1,675	6.8	28.2	13	34	—
12. Wyoming	1,651	6.5	44.1	5	35	—
13. California	1,574	2.3	9.6	1	29	56
14. Idaho	1,357	7.1	34.4	2	36	—
15. Mississippi	1,242	14.0	48.4	50	2	83
16. Illinois	1,228	5.9	25.5	6	20	1,425
17. Indiana	1,202	8.0	32.0	12	24	—
18. Oklahoma	1,178	12.1	68.1	23	47	116
19. Washington	1,089	5.8	18.4	3	26	—
20. Minnesota	1,011	6.8	32.8	13	22	—
21. Arkansas	1,050	8.0	29.5	30	3	128
22. Georgia	1,002	7.2	25.6	16	22	137
23. South Carolina	963	12.5	57.5	36	31	120
24. Missouri	955	9.3	39.4	23	25	268
25. Nevada	945	3.1	34.8	1	26	54
26. Alabama	910	11.8	48.3	41	13	221
27. Louisiana	905	7.2	19.8	24	11	63
28. Ohio	824	6.9	30.0	13	30	—
29. Michigan	734	6.7	28.6	24	31	—
30. Utah	725	5.3	34.6	6	41	—
31. Florida	567	1.6	4.1	14	8	136
32. Oregon	545	4.1	22.9	5	36	—
33. Tennessee	531	9.7	37.0	36	10	193
34. Delaware	525	1.5	7.1	4	26	—
35. New Jersey	498	1.6	6.5	30	20	—
36. Wisconsin	446	3.3	10.3	12	15	—
37. Alaska	393	2.6	[d]	—	—	—
38. North Carolina	373	4.6	14.0	20	28	304
39. New York	364	1.9	6.7	18	33	—
40. Kentucky	358	5.4	15.7	25	17	779
41. Maryland	347	1.7	6.9	4	18	—
42. Pennsylvania	310	2.3	9.4	8	22	—
43. Virginia	238	2.9	12.6	14	31	1,679
44. West Virginia	211	5.2	53.1	18	28	—
45. Vermont	189	1.0	3.6	47	—	—
46. Maine	186	1.0	4.6	5	—	—
47. New Hampshire	168	1.0	8.3	—	—	—
48. Connecticut	158	.5	1.8	—	—	—
49. Massachusetts	102	.4	1.8	—	—	—
50. Rhode Island	74	.3	3.5	—	—	—
United States	1,139	7.4	30.7	13	35	98

(Footnotes for Table 2 appear on following page) equal to 13 percent of the gross value of corn, grain sorghums, barley, and oats produced.[6] Payments to wheat program participants equalled 35 percent of total cash receipts from marketings; to cotton participations, 98 percent of total cash marketing receipts.[7]

In terms of value of production, feed grain payments ranged from less than one percent in New England and the Far West to 50 percent in Mississippi.[8] Wheat payments ranged from 8 percent of cash receipts in Florida to 79 percent in New Mexico. Cotton payments varied from 51 percent of cash marketing receipts in New Mexico to 1679 percent in Virginia. Although 1967 was an exceptional year, cotton payments exceeded receipts from marketings in 13 states.[9]

The differences among the states depend to a large extent on whether farmers in any given state can take advantage of cotton, wheat, or feed grain programs.[10] Obviously, those who have the most land and the largest bases can retire the most land and collect the largest payments.

States at the fringe of the major producing areas often have larger payments in relation to the value of production than in the higher producing states. Feed grain payments were relatively highest in the east, the northern fringe of the corn belt, and in the southeastern and southcentral states. Cotton payments were relatively highest in the states just north of the main cotton belt. This pattern indicates that direct payments offer a higher economic incentive than production in these areas.

The distribution pattern also shows that those states with highest payments in relation to income are those where one or more of the commodities with programs offering direct payments make up a sizable portion of

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[6] Calculated on the basis of total production and average price received in each state for corn, barley, grain sorghum, and oats. Total value was used rather than cash receipts from marketings because about 45 percent was used on farms where produced.

[7] The proportion was 3 percent in 1965; 69 percent in 1966. Total payments for 1968 were $787 million, indicating that the 1968 percentage will be close to 1966.

[8] Low states were New Hampshire, Massachusetts, Rhode Island, Connecticut, Nevada, and California. Mississippi appeared unusually high because of an apparent shift of feed grain base acreage into soybeans, permitted under ASCS regulations.

[9] Illinois, Missouri, Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Oklahoma, and Texas (see Table 2).

[10] Exceptions: Hawaii, Florida, and Louisiana, which in 1968 received payments from the sugar program of 98, 33, and 21 percent, respectively; 17 percent of Wyoming payments came from the wool program.

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[a] Calendar year total of direct payments divided by number of farms estimated by Statistical Reporting Service, USDA.

[b] Calculated with payments excluded from realized gross and realized net incomes.

[c] 1968 data on receipts from marketings by states were not available at time of writing; calculated with calendar year payments by commodity program divided by value of production of feed grains and cash marketing receipts of wheat and cotton, by states.

[d] See footnote 4.

Sources: [9, 11].

the cash receipts from farm marketings. In states with more diversified production, payments provide a relatively less important contribution to farm incomes.

Attempts to reduce support levels, acreage in land retirement, or direct payments would reduce the total program costs. But the net effect would be a reduction of transfer payments from the public to the agricultural sector and require economic adjustments for many farm operators. The shock would be less severe if adjustments were made over several years rather than all at once[4]. The above data indicate that cotton and wheat producers would be most seriously affected.

The Senate inquiry into direct payments [8] showing that 36 percent of the 1967 payments totalling $1.1 billion were distributed as payments of $5,000 or more, along with the Report on Rural Poverty [1, 5, 6], was largely responsible for the attempt to limit payments when the Agricultural Act of 1965 was extended in 1968. In future hearings Congress will likely be more responsive to the "needs of men rather than of land and commodities" [7, p. 1117].

On the other hand, will limitation of payments, to $20,000 or some other "reasonable" figure, accomplish the objectives sought? Or will it merely stimulate new leasing or tenure arrangements between landowners and tenants and a reshuffling of payments with other sharing of costs and returns to achieve compliance with the law? Further study and a trial period of program limitations may be necessary to answer these questions.

Nevertheless, the predicted time may be at hand when "farm program costs are headed for a direct collision with budget limitation objectives of the urban voter" [2]. Congress and the new administration in Washington may unconsciously follow the words of the late President Franklin D. Roosevelt, spoken in Brooklyn, New York, in 1940: "The test of our progress is not whether we add more to the abundance of those who have much; it is whether we provide enough for those who have too little."

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EDITOR'S NOTE: This section of the *Americal Journal of Agricultural Economics* may include comments on and replies to previous articles and other literature in agricultural economics, suggestions for improving the effectiveness of the AAEA, discussions of changes in emphasis needed within the profession, and contributions on other topics of interest and importance to agricultural economists. Manuscripts submitted for this section should be prepared in accordance with the guide appearing on the inside of the back cover of this issue and should not exceed 1,000 words.

Communications

ON SCIENTIFIC OBJECTIVITY: COMMENT

In a recent article in this Journal, Breimyer [6, p. 350] states that "unless agricultural economists in all forms of employ meet *all* the tests of a scientific discipline, including the test of objectivity, agricultural economics cannot wear the esteemed toga of a science." In accordance with this statement, Castle in his article [7] tries to classify the significance, meaning, and implications of scientific objectivity. Basing his approach toward objectivity on Karl Popper's famous and fundamental definition, the Popper-criterion [18], Castle tries to demonstrate the requirements that must be met by scientific research work in agricultural economics and farm policy as well as in all other parts of science. However, we believe he has made some fundamental misinterpretations and misunderstandings of the scientific process of discovering the truth.

1. Although he bases his argument on Popper, Castle nonetheless creates the impression, firstly, that personal objectivity is possible and permits one to reach unbiased results and, secondly, that such objectivity is constitutive for science.

Although he remarks initially that "the method is an impersonal one" [7, p. 809], yet the following argument sets out to show the threats to the "objectivity" of the individual whose "short-run individual self-interest . . . is not always enhanced by objectivity"[7, p. 810]. To assume that "objectivity is in the public interest" is to camouflage still further the underlying problems connected with the concept.

2. Today we know that objectivity in the "reine Vernunft" (pure reason) sense is no longer realizable as a voluntary act; that, on the contrary, every attempt to gain knowledge and solve problems is interwoven into the fabric of their sociocultural surroundings. Consciously or unconsciously, every effort is exposed to sanctions to conform—pressures that more or less prescribe standards of problem-solution. "Die Vernunft in jeder Gestalt ist ein sozialkulturelles Zuchtprodukt auf vitaler Grundlage"[1] [2, p. 93; cf., also, the references mentioned here].

3. It is thus evident that an indi-

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[1] Reason in every form is a social and cultural product cultivated on an ever-changing foundation.

vidual cannot achieve his aim to ascertain an objectively valid view of reality and its potentialities [cf., also, 19, p. 267]. Objectivity in this sense cannot be constitutive for the concept of science. Instead, as a prerequisite for the functioning and validity of science, there must be a "Kommunikationsgemeinschaft" [3, 4], i.e., a circle of researching scientists in communication with one another. This circle would reach a consensus on a minimal norm, roughly in the manner presented in Popper's postulated critical rationalism, which implies intersubjective cross-examination and access to such critical examination [1, 19, 20].

Scientific objectivity thus becomes not the result of the isolated individual's striving for impartiality "but a product of the social or public character of scientific method; and the individual scientist's impartiality is, so far as it exists, not the source but rather the result of this socially or institutionally organized objectivity of science" [19, p. 220].

4. Since Castle maintains that "individual altruism is a shaky foundation on which to base objectivity" [7, p. 810], why does he concern himself —as he does superficially anyway— with threats to this type of personal objectivity instead of examining those social institutions that are the *sine qua non* of science (places of scientific research, magazines, scientific conferences) and their potential to guarantee general accessibility to scientific work and intersubjectivity as a permanent form of criticism?

5. If we assume—as Castle does—that "objectivity is in the public interest" [7, p. 810] and if we suppose that the public interest is represented by ruling elites (cf., for example, the political theory of Schumpeter [22]), then there is no reason to assume that the scientific institutions should not also be organized with the goal of maximal objectivity. And in fact there are plenty of examples that can be quoted—at least in the domain of our technical knowledge (including social technology)—which succeed in keeping a minimal standard of intersubjective cross-examination [21, 23, and the references given there]. This they do by striving for the greatest possible "Wertfreiheit" within their system of declarations, that is, in the domain of their "Objektsprache" where value-free statements are possible. Not to achieve this norm is in effect to exclude oneself from the process of science.

6. But if science is to avoid becoming an ideology[2] [10, 11], it cannot simply be viewed as a "handmaiden to policy" [6, 14], devoted to making possible "zweckrationales Handeln" (rational behavior for the object in view) in Weber's sense of that term [24, 25] if, at the same time, it abandons critical communicative action and thereby permits irrational decisions ultimately to become dogmatized [2, 8, 9].

If science is to be more than a legitimizing instrument of authority, it must overcome the positivistic dualism of knowledge and decision-making,[3] i.e., it must enter a critical interdependence relationship with policy-making. And while serving toward the solution of technical questions, science must also adopt an "emancipatory interest in knowledge" [9]. A successful transference of technical and strategic recommendations into practice is thereby referred to the mediation of the public [9, p. 129]. That is, a critical interdependence relationship between science and policy-making within a democratic framework is connected to and dependent upon a communicative feed-back with an enlightened and self-conscious public.

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[2] Ideology in the sense of a social doctrine of justification (a "Rechtfertigungslehre").

[3] We cannot here go further into the differences between the conceptions of a revised positivism (Popper; Albert) and representation of the so-called critical theory (Adorno; Habermas) [cf., for example, 25]. But just recently a certain convergence can be noticed.

7. It is evident that under present-day circumstances criticism of ideology and aims is, as a rule, at variance with the so-called public interest represented by elites. That is, the autonomy of scientific institutions is permanently threatened.

It has to be asked to what extent such autonomy still exists today in concrete terms; and these doubts are nourished by the present "university crisis" to be seen the world over [12; cf., also, 15 and 16] which to a large extent can be interpreted as a protest —coming in the main from students —against the intrusion of sectarian ideologies, disguised as "public interest," into the sphere of science.

8. Even if one were inclined to admit that "objectivity is in the public interest"—which, as said above, is doubtful enough—there is, however, no criterion for objectivity that could enable the scientist "to formulate and advocate a position on a particular policy at a point in time" [7, p. 810]. We are always lacking significant and necessary information [5], and even if this were available, it will prove impossible to transform such information into a consistent system for operational action in economic policy [13].

Instead of justifying actions of policy, there thus arises the need to question critically and rationally every dogmatized standpoint of science and of policy.

The prerequisites for this are, of course, (a) that the scientific process run its course in unlimited material and ideal freedom [2, p. 173], for only in this way can the prerequisite be created for the intercommunicative process of discovering the truth; and (b) that the public be brought without impediment into the interdependence relationship between policy and science so that the latter may exploit its controlling function with regard to the application of the technologists that science puts at the disposal of policy.

9. And, finally, a remark of a more general nature: Time and time again the European observer is struck by the fact that Castle's criterion for intersubjective cross-examination of scientific theories, mentioned at the outset, is frequently impaired in this Journal by the failure of authors to discuss and to accept scientific knowledge—even in the field of epistemology—which is formulated in any language other than English.

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ON SCIENTIFIC OBJECTIVITY: REPLY

I am grateful to Schmitt and Timmerman for their comment on my article [1]. I am in basic agreement with them, even though they do not seem to believe they are in agreement with me. In any case, their comments permit discussion of several subjects that were eliminated from an earlier draft of the article. Our profession has neglected issues of this type, and I would be pleased if this Journal were to become a focal point of such discussions in the future.

1. Schmitt and Timmerman's final point may well be their most important. Comments and original articles by Europeans and others who draw on the non-English literature will add strength and new dimensions to the Journal. Readers will appreciate their list of references; some of these were not familiar to me, even though I do not believe their methodological arguments are substantially different from the position on which my article is based.

2. While my article may be misleading because of its brevity, it was based on the same methodological position regarding individual objectivity as stated by Schmitt and Timmerman. However, I believe Schmitt and Timmerman fail to grasp two fundamental points:

a. Even though "scientific results" depend on the process of science rather than individual objectivity, the individual research plays a role in that process. Unless the conditions are present so that he can pose refutable hypotheses, test these in an appropriate fashion, and subject his method and results to scrutiny, meaningful replication cannot occur. And, if meaningful replication cannot occur, we will never achieve "a consensus on a minimal norm, roughly in the manner presented by Popper's postulated critical rationalism, which implies intersubjective cross-examination and access to such critical examination" (Schmitt and Timmerman). The section on "Threats" in my article was an attempt to illustrate the relationship between socio-cultural surroundings and attempts to gain knowledge.

Part of the difficulty in communication may result from the failure of Schmitt and Timmerman and myself to point out that objectivity can never be measured by an absolute standard if one takes into account the source of the hypothesis. I call particular attention to the last paragraph and footnote 7 in my original article [1, p. 813]. It is always possible to develop alternative hypotheses about the same phenomena. If Schmitt and Timmerman are saying we should move in and out of particular analytical frameworks in developing alternative hypotheses, I take my stand with them on this also.

b. Economics as a science has not yet progressed to the point where replication and cross-examination of another's work will automatically lead to a consensus. Under these circumstances, we all need to identify our value judgments and make them as explicit as possible. This is a necessary step in reaching consensus. If the "Threats" section has value, it is in encouraging economic researchers to be more aware of the source of such possible values.

3. Another fundamental point pertains to my tentative assumption that scientific objectivity is in the public interest. I accept the criticism. As a matter of fact, in the original manuscript I discussed this subject at some length under the heading of "Economics and Objectivity." The elimination of this section created confusion. However, the foundation of my article is the position taken by Schmitt and Timmerman that there are no settled questions in science. I agree that a person who takes a policy position may be taking "rational behavior for the object in view" (Schmitt and Timmerman), and is not, in that case, acting as a scientist. Nevertheless, there is obvious hazard of doing that

in the public arena while attempting to retain sufficient flexibility to embrace additional information, when this additional information may indicate a different course of action to be more rational. A careful reading of my article will show that I believe the "public interest" to be an unworkable criterion, given the present state of the arts. It was for this very reason the article was written; I did not believe that only research undertaken under the heading of enhancing the "public interest" should be classed as scientific. I call particular attention to footnote 6 in my article, as well as the concluding sentence.

4. Finally, I again express my appreciation to Schmitt and Timmerman for extending my article in a useful direction. When my article was submitted for publication, I devoted considerable space relating the considerations discussed by Schmitt and Timmerman to that part of my article which was eventually published. It was suggested by the reviewers the article should be shortened to "Communication" length and I attempted to comply, even though the manuscript was eventually published as an article. In retrospect, I believe I should have insisted on the length of the original manuscript, because the type of misunderstanding that resulted could have, in large part, been avoided.

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Reference

[1] CASTLE, EMERY N., "On Scientific Objectivity," *Am. J. Agr. Econ.* 50:809–814, Nov. 1968.

U.S. IMPORT DEMAND FOR GREEN COFFEE BY VARIETY: COMMENT

Abaelu and Manderscheid have investigated an interesting topic [1], but their results are less informative than they seem to realize and much less useful than they might easily have been.

1. The decision to use only Colombian imports to represent milds ("U.S. demand for milds is measured by U.S. coffee imports from Colombia, the biggest producer" [1, p. 236]) was unfortunate and clearly improper on their own description: "While Colombia supplies the bulk of world requirements for milds, other important sources of this coffee variety in the western hemisphere include El Salvador, Guatemala, Costa Rica and Mexico" [1, p. 232].

Equation (1) on p. 237 and p. 239 is, therefore, *not* the import demand function of the U.S. for milds but the import demand function of the U.S. for Colombian milds. "Other milds" were imported by the U.S. in slightly smaller amounts than Colombian milds in 1953, and if the approximate equality had held, there would have been no problem; but, in fact, the ratio of Colombian milds to other milds declined through the period from about 1.1 in 1953 to about .7 in 1961 [2, pp. A 106–7]. There was, therefore, no linear relation by which the coefficients of the total milds import equation could be calculated from the coefficients of the Colombian milds import equation.

Either the other milds should have constituted a separate category or the Colombian and other milds combined into a total mild aggregate and a price index for the group calculated.

The separate category procedure is clearly preferable. It was not made clear in the article that coffee is classified by the International Coffee Organization into two principal groups, arabicas and robustas. The arabicas are subdivided into Colombian milds, other milds, and unwashed arabicas (Brazils).[1] If four, rather than three categories were used, then a generally closer price substitute than Santos 4 could have been used for Colombian milds, i.e., prices of other milds, such as El Salvador Central Standard, Guatemala Prime Washed, and Mexico Prime Washed.

2. Similar objections can be made to the Robusta and Brazils equations. Imports from Angola and the former French West African territories, used by Abaelu and Manderscheid to represent total U.S. demand for Robustas, were 79 percent of all Robusta imports in 1953 but were down to 54 percent by 1963 and to 49 percent by 1966 [2, pp. A 108–9].

For the Brazils, the problem was much smaller, since Brazil dominated the category, but yet the ratio of imports from Brazil to total imports of Brazils varied from 98 to 92 in the sample period [2, pp. A 106–9], causing at best errors of observation seemingly unnecessary since only Bolivia and Ethiopia need be added to have the entire category accounted for.[2]

3. The data defects caused by using "representative" countries rather than the actual totals may also be involved in the poor performance of the export supply and stock demand functions for each category (of the fifteen variables used in equations 2, 3, 5, 6, 8, and 9, only one was significant by the usual standards). Abaelu and Manderscheid estimate the quantity of each variety in total stocks "[by] multiply[ing] total stocks by a number representing the proportion of that variety in total coffee imports in the current quarter" [1, p. 236]. Without reference to its theoretical validity, this procedure does not work because the proportion each representative group is of the total of representative imports does not correspond to the proportion actual imports of that category bear to the total of actual imports. For example, in 1961 the comparable proportions for milds were .28 (Abaelu and Manderscheid) and .44 (actual); Brazils, .59 and .41; and Robustas, .13 and .14[3]

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[1] In the first years of the International Coffee Agreement, the Colombian milds and the other milds were combined into a single 'mild' category and the price of milds were calculated by averaging the three cited prices and then averaging that mean with the price of Colombian milds. The second procedure suggested would thus use the initial coffee classification of the International Coffee Organization.

[2] The regression of Brazil's annual share on time was $\underset{(-1.94)}{94-.28t}$ for 1953–61 and $\underset{(-3.96)}{94-.70t}$ for 1953–66, where the expression in parentheses is the t-score.

[3] The example is representative. The closest approximations were in 1953: milds, .41 (Abaelu and Manderscheid), .56 (actual); Brazils, .53 and .58; and Robustas, .07 and .06 [2, pp. A 106–9 and A 86].

4. Abaelu and Manderscheid conclude from the sign of the income coefficients in their import demand equations that Colombian milds is a normal good (sign positive) and the Brazils and Robustas inferior goods (signs negative). "Other relevant factors remaining constant, further growth in the U.S. per capita disposable income should boost the demand for milds in the United States" [1, p. 240].

The cited evidence from the Colombian milds equation is not persuasive, the income coefficient being positive but no larger than its standard error. Other evidence, of the kind predicted by Abaelu and Manderscheid, is against the normal classification. Both the quantity and the share of Colombian milds in all coffee imports declined (significantly) from 5,606 thousand bags (27 percent of all coffee imports) in 1953 to 2,716 bags (12 percent) in 1966 [2, pp. A 106–7 and A 86], surely not the quantity behavior expected of the only normal variety in coffee.[4] Moreover, the share of Colombian plus other milds in total coffee imports also declined from 51 percent (1953) to 39 percent (1966) [2, pp. A 106–7 and A 86].

In comparison, the total imports of Robustas were 856 thousand bags in 1953 and 4 percent of total coffee imports. The imports of this inferior variety rose steadily to 5,964 thousand bags in 1966 and 27 percent of total imports [2, p. A 86].

Abaelu and Manderscheid are conscious of some interpretative difficulties: "Because of high intercorrelation with income, the trend variable was dropped. Thus, the model might attribute the effects of technological progress and changes in consumer taste to the income variable" [1, p. 240]. It is, therefore, all the more surprising that they did not use the wealth of annual, quarterly, and monthly information on coffee in the entire postwar period to provide better estimates and stronger findings.

Certainly, their reason for not using the later data is weak: "The period subsequent to 1961 was excluded because of the International Coffee Agreement, which is believed to have caused extensive changes in the conditions underlying coffee marketing" [1, p. 236]. International control of coffee supplies to achieve price objectives will add another argument to the supply function but is irrelevant to the import demand function. And, given the poor results achieved in all the supply equations for 1953–61, there would have been little to lose on supply and much to gain on demand by extending the sample period as far as possible.

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[4] The price of Colombian milds increased relative to Brazils from 1953 to 1961, but not over the entire period 1953–66 [2, pp. A 130–1].

References

[1] ABAELU, JOHN NDUKA, AND LESTER V. MANDERSCHEID, "U.S. Import Demand for Green Coffee by Variety," *Am. J. Agr. Econ.* 50:232–242, May 1968.

[2] Pan American Coffee Bureau, *Annual Coffee Statistics, 1966,* New York, 1967

U.S. IMPORT DEMAND FOR GREEN COFFEE BY VARIETY: REPLY

Professor Hughes has made a number of suggestions worthy of consideration in any extension of the earlier study by John Abaelu[1] and myself. On the other hand, his conclusions require tempering. When our study was conceived, we were unaware of published statistical studies of coffee demand that attempted either to differentiate varieties of coffee or to study the demand-supply interaction in the market. Rather, most previous attempts concentrated on total coffee demand. One of our major objectives was testing whether or not the several varieties behaved differently in the market. Professor Hughes concedes implicitly that we found differences by suggesting further disaggregation. Certainly our attempt should not be thrown out because it does not disaggregate enough, unless either the results are incorrect (or misleading) or one has a better alternative.

The specific objections raised by Professor Hughes in points 1 through 4 are worth serious consideration for future studies. We were not unaware of these objections—but they are not as serious for our sample period of 1953–61 as they are for longer periods suggested by Professor Hughes. New studies should not only consider the International Coffee Agreement in the supply equations but should also include other policy variables such as export taxes. Professor Hughes could also have pointed out that coffee from any one country is not homogeneous within a year nor is the average quality homogeneous over time. Therefore, neither use of representative prices (of a single grade) nor of total quantity (without reference to quality) is completely valid; both are approximations useful for many purposes.

There are other deficiencies in our study; hopefully, someone will accept the challenge to do further work in the area.

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[1] Mr. Abaelu is unable to comment because of conditions prevailing in the Biafran section of Nigeria.

THE EFFECT OF A MARKETING ORDER ON WINTER CARROT PRICES: COMMENT

In the November 1968 issue of this Journal, Professor Carl E. Shafter [1] examined the effect of a marketing order on winter carrot prices. We wish to suggest that there are some logical inconsistencies in his paper that appear to arise out of improper specification, and hence the conclusions inferred from the statistical results were not warranted. Instead, we wish to submit our own hypotheses, quite opposite to those of Shafer's, and contend that our explanatory hypotheses are more reasonable—at least from the standpoint of traditional microeconomic theory—and that his statistical findings are not inconsistent with our postulates.

We are indebted to G. Edward Schuh for encouragement and helpful comcomments.

First, we summarize some of the important observations made by Shafer:

1. Before the imposition of a marketing order in Texas in 1960, Texas and California both produced winter carrots and competed in several markets throughout the U.S. with the relatively low quality Texas carrots receiving the lower price.

2. After the imposition of the marketing order, which had the effect of narrowing or eliminating the quality differential between Texas and California carrots, it was seen that (a) there was a convergence between the prices of carrots from the two areas, and (b) a convergence between the grower price and the f.o.b. price, or the price received by shippers, in Texas.

To explain the price behavior between pre- and post-order periods, Shafer offered two hypotheses:

1. The imposition of the marketing order had the effect of making Texas carrots more comparable in quality to the California carrots and thus increased the demand for Texas winter carrots, raising their price, and narrowed the price differential between the two areas, as indicated by terminal market prices.

2. The advent of the order and the resultant improvement in the quality raised the derived demand faced by Texas growers while leaving the demand curves at the shipper level unchanged thus bringing about a convergence of grower and f.o.b. prices in Texas.

An examination of the above hypotheses reveals that Shafer utilized a demand-biased model to explain observed price behavior. We wish to suggest, instead, that a supply-biased model is more relevant insofar as the effect of the marketing order would primarily be on supply rather than on demand.[1] For unless one is willing to accept the hypothesis that a market order alters the utility functions of the final consumers and hence shifts their aggregate demand for carrots, there is no reason to expect shifts by the derived demand curves at the grower and shipper (f.o.b.) levels.[2]

In what follows, we shall take Shafer's price observations as given and offer likely alternative hypotheses of our own. We do not claim that ours are the true explanations. Instead, our aim is to show how a supply-biased model might explain the same observation. We shall make only those assumptions that yield the simplest and most clarifying explanations while noting that more complex assumptions would change the magnitudes of the results but not their substantive relations. Finally, we shall point out important differences in policy implications to be deduced from our model vis à-vis Shafer's.

For our model, we shall first redefine our market for carrots. Instead of having only Texas carrots and California carrots, we also explicitly differentiate between high quality carrots and low quality carrots. By so doing we are adding additional demand and supply considerations which we feel are helpful for a clear explication (below) of the price and market order relations.

First, we assume the existence of two final market demand curves—one for high quality winter carrots (D_h) and one for low quality winter carrots (D_l). Similarly, we have two supply curves (S_h and S_1). For the sake of simplicity we assume the supply

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See also [2].

Except as indicated below. See footnote 3.

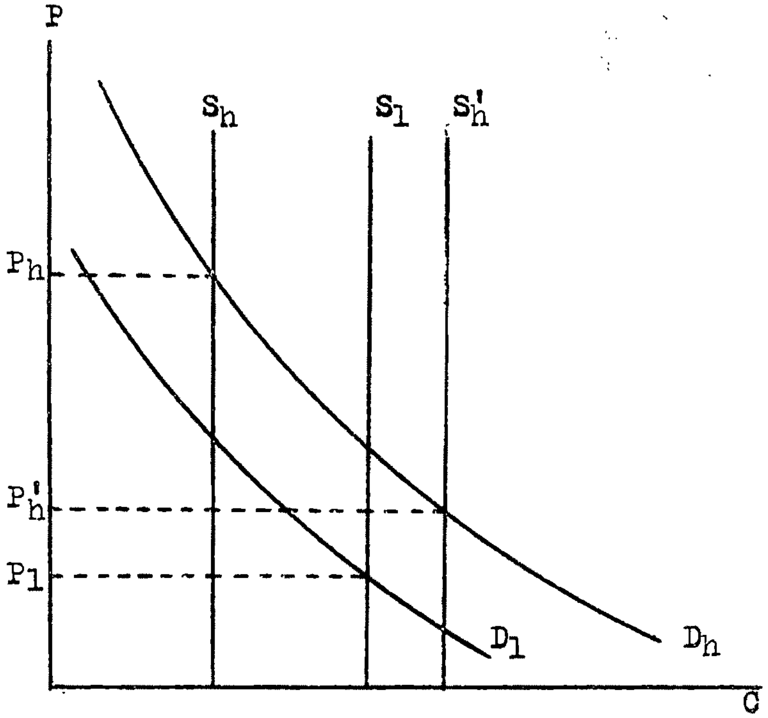

Figure 1

curves to be zero elastic. Finally, assume that prior to the order all the carrots supplied by California were high quality carrots and those supplied by Texas were low quality carrots; and after the order, both states supplied only high quality carrots. The explanatory hypothesis about the convergence of terminal Texas and California prices can be inferred from Figure 1.

Prior to the order, the price of California winter carrots was P_h and that for Texas was P_1. After the advent of the order, we have only one supply curve for carrots (S_h') which is the summation of the California and new Texas supplies. The price now received for both Texas and California winter carrots are P_h' and hence demonstrates the convergence of terminal prices for carrots from these two areas.

It is important to note that the effect of the order was on supply and not on demand. The order altered the market for carrots from a two-commodity (high and low quality carrots) to a single commodity (high quality carrots) market. The demand curves remained unchanged since there appears to be nothing inherent about a market order that alters the preference functions of the final consumers and hence their aggregate demand.[3]

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[3] It is possible that final demand for high quality carrots may have changed [see 2, p. 1362] as a consequence of either a reduction or elimination of low quality carrots from the market. That is, if low and high quality carrots are substitute commodities to the final consum-

If the final demand for winter carrots did not shift after the imposition of an order in Texas, what would cause the derived demand facing the Texas growers to rise as postulated by Shafer? On the other hand, if the final demand did change, then the change will alter the f.o.b. demand as well as the demand faced by growers. But by stating that the f.o.b. demand was unaffected by the order, Shafer would be hard put to explain why the derived demand facing the growers increased. In short, there appears to be some inconsistency in his model. Yet, unless he could make claim to an unchanging f.o.b. demand as well as a changing derived demand facing growers, he would be unable to explain the convergence between grower and f.o.b. prices.

Again, we suggest that it is more fruitful to examine the problem from the supply side. It is possible that one of the effects of the marketing order is to alter the competitive character of the market structure at the grower level [2, pp. 1362–1364]. In the extreme, it changes the market from one of many small sellers to one of a single large seller. The result is that it alters the bargaining strength of the Texas growers vis-à-vis the shippers. And since the competitive structure of the shippers' market is unaffected by the order, the growers, with increased power, may gain at the expense of the shippers through the reduction of the margin between grower and f.o.b. prices.

We have offered two alternative hypotheses here about the price observations made by Shafer. To reiterate, we do not claim that ours are the true explanations. Instead, what we have argued is that a supply-biased model is more reasonable than a demand-biased model for the explanation of the effects of a marketing order. The statistical results presented by Shafer are not inconsistent with our postulates.

More importantly, whether the effects of a marketing order are on the supply side or on the demand side has profound policy implications. For instance, it has often been argued that marketing orders should be imposed in order to raise the income of farmers. Indeed, if a marketing order could raise demand, it becomes a powerful means of raising the level of farm income. On the other hand, if it operates primarily through supply shifts, its effects on farm income would depend on the elasticity of demand. Since demand for carrots is probably elastic, the effect would most likely be to *reduce* income (gross) to the farmers. This might explain why the Texas carrot growers voted out the order after a brief trial.[4]

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ers, the elimination of one may alter the demand for the other. For instance, one might postulate that the demand for high quality carrots may become less elastic. But if there is indeed an alteration of demand on the part of the consumers, it is the result of the order's effect in changing the composition of goods supplied. Moreover, if the demand is changed in the final market, similar effects will be evidenced in the derived demands at the f.o.b. and the grower levels. Shafer, however, denied that the f.o.b. demand was changed by the order, from which we inferred that the final demand did not shift. In any case, even if we allowed a shift in the final demand, the price received for Texas and California carrots after the order would be the same, since the order eliminated the supply curve for low quality winter carrots.

[4] We thank G. E. Schuh for raising this point.

References

[1] SHAFER, CARL E., "The Effect of a Marketing Order on Winter Carrot Prices," *Am. J. Agr. Econ.* 50:879–87, Nov. 1968.

[2] TOWNSEND-ZELLNER, NORMAN, "The Effect of Marketing Orders on Market Structures and Some Consequent Market Development," *J. Farm Econ.* 43: 1357–1365, Dec. 1961.

THE EFFECT OF A MARKETING ORDER ON WINTER CARROT PRICES: REPLY

First, let me correct an error brought to my attention by Mark Fowler as this may help in discussing Beighley and Mak's comment. In the paper in question, a hypothesis is presented that the derived demand for Texas winter carrots shifted upward and to the left during the order period [1, pp. 879, 886], an obvious contradiction which interpreted literally means the derived demand shifted up (or right) *and* left (or down). My error. The reference to a leftward shift in the derived demand may be cleared somewhat but certainly not absolved by correcting the typographical error in the last line of the second paragraph on page 886 which should have read, "The latter or volume effect is essentially a movement along the higher demand relation." rather than ". . . a movement along with the higher demand relation." Such movement to the left along the higher demand relation would, in effect, be a drop in supply since more stringent grading would be expected to reduce the proportion of total production actually shipped or sold. This supply effect or reduction in the proportion of the crop actually sold was not evaluated in the paper.

The hypothesis that the derived demand for Texas winter carrots did shift upward or to the right was based on (a) improved quality due to more stringent grading and (b) an undifferentiated reference to ". . . the possible effects of any of the several market organizing features of an order" [1, p. 881]. The next sentence in the text suggests that the order was responsible for the reduction of market imperfections within the supply area and refers implicitly, in part, to a possible increase in the bargaining power of growers (in-field level) vis-à-vis shippers (f.o.b. price level).

Although Beighley and Mak's comments forced me to examine the paper from another perspective—the supply-biased model—I will argue for the "demand-biased" approach. In terms of microeconomic theory Beighley and Mak are correct in that this was not a shift in demand as traditionally associated with changes in (a) the prices of related commodities, (b) income and/or (c) tastes and preferences of consumers. Insofar as improved quality was responsible for higher prices at the grower level,[1] the higher demand relation would, as Beighley and Mak state, be for a different commodity; i.e., higher quality carrots. However, the extent that the higher demand relation was due to the improved bargaining position of the growers vis-à-vis the shippers would be due to an upward shift in derived demand. Such a "shift" would be possible because of "imperfections," in the market, which the "market organizing features" of the order may have both illuminated and, to some extent, removed. I accept Beighley and Mak's hypothesis that the marketing order might "alter the competitive character of the market structure at the grower level." In fact, I believed that I had included the same reasoning, although perhaps too thickly veiled, as support for the "demand shift" hypothesis.[2]

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[1] Improved quality at the grower or field level could have been due to increased field grading as mentioned on page 885 of the article.

The partial point price flexibilities for Texas growers for the eleven years computed from Table 1 of the paper varied from −0.52 (1954) to −3.18 (1960) with the price flexibility at the means being about unity. This meager evidence suggests that Texas growers would at least be interested in avoiding large crops because of the associated decreases in gross returns. However, in addition to the partial price flexibility associated with quantity, the price flexibility associated with quality (price response to improved grade of commodity) is also relevant in considering the total returns position of the growers as was discussed briefly in the last paragraph of the article.

The South Texas carrot order was voted out in April of 1966 largely due to high prices, short supplies, and the administrative committee's unwillingness to reduce the length of carrots eligible for consumer cello packs. The order committee was using size requirements in an attempt to regulate supply. However, this technique discriminated against the relatively high rainfall areas in that many carrots from these areas did not meet the minimum length requirements. One thing led to another, including some element of the grower-price—shipper-volume conflict, and the order was defeated.

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[2] See the first paragraph on page 881 of the article in question.

Reference

[1] SHAFER, CARL E., "The Effect of a Marketing Order on Winter Carrot Prices," *Am. J. Agr. Econ.* 50:879–87, Nov. 1968.

FOOD DONATION PROGRAMS

Food donation to low income families illustrates the principle that the shortest political line between two points is a jagged one. Such a line can touch the most areas of support and detour part of the opposition. However, a program so contrived can also confound analysts, both friendly and hostile.

Food donation began as much to relieve the federal government of embarrassing farm surplus as to help recipients. It has been progressively directed toward the latter objective. Throughout, the program has been kept separate from public assistance.

Consistent therewith, food donation has come to be justified in terms of relieving malnutrition. It is tested in the publicity crucible on the grounds of how effectively it does so. Once it was vilified as giving too little, or too plain, food. John F. Kennedy's West Virginia campaign led to quick correction after he became President. A common charge now is that the program reaches too few.

Another current objection is of different timbre. Critics with welfare orientation oppose aid in kind. They want dollar aid only, which, less paternalistic, lets families balance food with other needs.

In large measure this second debate is semantic exercise. Families receiving donated food are able to incorporate that income-in-kind into their total expenditure pattern. That is, they have a wide range of choice as to the extent to which they substitute that food for their normal food purchases, thereby freeing dollars for discretionary use. In this respect food received becomes the equivalent of ordinary income.

This is true for families that previously were not destitute—that made substantial expenditures. It is true so long as donations are modest in scale and the kinds of food received do not clash with families' food tastes.

These basic issues underlay a study of the Commodity Distribution Program in Harrison County, Missouri, made in the summer and fall of 1967 [1]. The distinctive feature of the study was that it straddled initiation of the program: families eligible to receive food were surveyed before distribution began and again three months after it was instituted.

Most trenchant finding was the high degree to which families substituted donated foods for their pre-program purchases. That food donation would have this consequence has often been alleged, but this study is one of the rare instances where empirical data are citable. In Harrison County substitution appeared to be essentially total; but before data are converted to dogma, possible inaccuracies must be noted. Families are clearly inexact in their reporting; for example, diary data for food expenditures under the program exceeded memory estimates by 40 percent. Seasonality and opening of school impeded precise reporting.

More meaningful and trustworthy are differences by kinds of participants. Families who spent most for food before the Program began were quickest to use donated food to save money. These were the largest families. Though much is written popularly about the destitute aged, in Harrison County the low-income younger families with children seemed to be in the tighter straits. To them, apparently, donated food was surrogate for shoes for kids. However, medicine was named as first claimant on freed funds and fuel second. Clothes were third.

Were diets left unimproved? Data from the study are sketchy, yet those collected seem to show some nutritional gain. Data assess adequacy of servings of food within each of four food groups. For three of the groups, a higher percentage of families showed an adequate number of servings after the program began than before. Only for one group did families slip back. Moreover, after food distribution began, about 59 percent of households receiving food met standards for two, three, or four of the groups, compared with 49 percent before the Program came to the county.

Thus, the burden of nutritional advancement is put on the quality of the foods distributed. Though families had previously not starved, neither had they enjoyed particularly good diets. Apparently, if donated foods are to enhance diets, they themselves must be nutritionally superior. It is not safe to rely on families using freed dollars to buy the nutritionally better foods.

Matching the findings of the study against social philosophy and principles of government is not easy. Obviously, justifying food programs solely in terms of feeding hungry or malnourished people contains sleight of hand, if not hypocrisy. But by the same token, thereby is denied the charge of paternalism. Donated food is indeed income-in-kind, to very considerable degree; the program allows much latitude as to the disposition of the dollar value of the food that families receive.

Then why not just give the families money? Though this might be the best policy, two counter-arguments carry weight. One is that the families do improve their nutrition to some extent, especially if good food is distributed. The second, a political one, is powerful: so long as the federal government accumulates surplus food, or so long as it sees total food production as excessive, it is far more feasible to win majority support for food distribution than for substantially increased welfare payments. This latter is not an irrelevant consideration.

Yet the most penetrating conclusion may be still different; it is that those families who must use any chance to save a few dollars in order to pay medical bills and to buy fuel and clothes are living on the brink of desperation, by any enlightened criteria. Further, within the class of the population qualifying for public assistance and food distribution lie a wide range of circumstances and highly varying degrees of need. Criteria for eligibility based on income alone (relative to family size) with a single, discrete cut-off line help to account for the varying degree to which donated food translates into better nutrition vs. income for paying non-food bills.[1] Food program experiences may also confound, yet partly correct, middle-class ideas as to the nature of a sizable separate world.

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[1] This relates to the principle, so long employed in consumption and expenditure analysis, that income essentially guides family expenditure. A protest literature is building up. See, e.g., Wasson: ". . . many marketing people still [erroneously] treat income level as synonymous with social class and as a sound guide to spending patterns" [2].

References

[1] LOYD, HAROLD J., AND HAROLD F. BREIMYER, *Distribution of Food To Lower Income Families in Harrison County*, University of Missouri Special Report 104, Feb. 1969.

[2] WASSON, CHESTER, "Is it Time to Quit Thinking of Income Classes?" *J. of Marketing*, 33(2):54–57, April 1969.

A COMMENT ON A TRADITIONAL BEHAVIOR MODEL

In an unnecessary controversy between Yotopoulos and Wise [3, 4, 5] and Johnson [1, 2], the reader of this Journal is given the following model of traditional behavior:[1]

$$H_0\colon \max U(R, C) = \log R - C = t$$

with the properties

$$\frac{\partial U}{\partial R} = \frac{1}{R} > 0,$$

i.e., diminishing marginal utility of revenue (or output) and

$$\frac{\partial U}{\partial C} = -1 < 0,$$

i.e., constant marginal disutility of cost.

Johnson [2, p. 209] has argued that this is a strange model because for plausible values of R and C utility is negative, and marginal disutility of cost is always greater than the marginal utility of revenue.

Yotopoulos and Wise [4, p. 209] disagreed with Johnson, pointing out that units of measurement are arbitrary and and therefore "plausible" values is an ambiguous term, and specify their model as

$$\begin{aligned} U(R, C) &= \log (aR) - (aC) \\ &= \log a + \log R - aC \end{aligned}$$

which has a maximizing equilibrium, since

$$\frac{\partial U}{\partial R} > -\frac{\partial U}{\partial C} \qquad \text{for } 0 < R < 1.$$

My comment is that this model, even adjusted for the unit of measurement, remains a strange one. The range of values of R for which the model has maximizing equilibrium is not $0<R<1$, but $0<R<1/a$, i.e., the range of values of R depends on the selection of a. For $R=1/a$,

$$\begin{aligned} U(R, C) &= \log a + \log \left(\frac{1}{a}\right) - aC \\ &= -aC < 0. \end{aligned}$$

For $R=1/ab$, where $b>1$ so that $0<R=1/ab<1/a$,

$$\begin{aligned} U(R, C) &= \log a + \log \left(\frac{1}{ab}\right) - aC \\ &= -\log b - aC < 0; \end{aligned}$$

that is, if the model is to have maximizing equilibrium, then U is negative. Since $-\log b - aC < -aC$, at $R=1/a$ the firm is minimizing negative utility.

The conclusion is that even in this general formulation the traditional model proposed by Yotopoulos and Wise cannot be considered as a rival model to profit-maximization and/or fixed proportions models.

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[1] See [3, p. 204]

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EPILEGOMENA ON TRADITIONAL BEHAVIOR MODELS

The comments raised by our empirical formulation of the model of traditional behavior [1, 2, 3, 4] indicate that sight of the forest has been lost for the trees. In a way of clarification, we apply the hatchet on the trees that have confused Dr. Lianos by formulating the model in its general form.

(i) Our traditional model specifies a utility function, $U(R, C)$, which the decision-maker (the farmer) attempts to maximize, subject to constraints imposed by the production function and the price equations for capital inputs, labor inputs, and output.

(ii) The returns function is of the form $R_i = A_i F(K_i, L_i)$, where A_i, a production efficiency parameter, varies from farm to farm. The costs function is $C_i = G(K_i, L_i)$. In our application, F and G take specific forms; but never mind, here.

(iii) The hypothesis of maximizing behavior (be it in a profit or in a traditional world), max $U(R, C)$, implies $\partial U/\partial K_i = 0$, $\partial U/\partial L_i = 0$. These partials do not involve A_i. Thus, when U is maximized, K_i and L_i are constants independent of A_i. Similarly, F and G are constants which we may denote by F^* and G^*.

Then it follows that, for max U

(1) $$R_i = A_i F^*.$$

This can take any value between 0 and ∞ as A_i increases from 0 to ∞.

(2) $C_i = G^*$, a positive constant for all A_i.

(iv) We defined traditional behavior as maximization of a specific form of the general utility function, i.e.,

$$\begin{aligned} \max U_i &= \log R - C \\ &= \log (A_i F^*) - G^* \\ &= \log A_i + \text{constant}. \end{aligned}$$

Thus max U can take any value between $-\infty$ and $+\infty$ as A_i varies from 0 to ∞.

(v) Even if max U is negative, it should not be disturbing or implausible to minimize disutility. This seems to us as reasonable as maximizing utility. Moreover, this non-problem disappears completely if we treat the utility function as ordinal or as cardinal but with undefined choice of origin.

(vi) No meaning is to be attached to "plausible" values of R, C, or U since they are, from (iii) and (iv) above, functions of A_i.

(vii) No significance is to be attached to $\partial U/\partial R < \partial U/\partial L$ or, for that matter, to $\partial U/\partial R > \partial U/\partial L$ even if these should occur everywhere. For example, for our second hypothesis, H_2, $U(R,C) = R - aC$, $(a \neq 1)$, if $a > 1$, optimal output is less than profit-maximizing output; while if $a < 1$, optimal output exceeds profit-maximizing output. In this case $\partial U/\partial R = 1$, $\partial U/\partial C = -a$.

(viii) Furthermore, the values of $R = C$ for which $\partial U/\partial C \geqq -\partial U/\partial C$ are totally irrelevant to the existence of the optimum, the relevant maximization conditions being $dU = (\partial U/\partial R)dR + (\partial U \partial C)dC = 0$ and *not* $\partial U/\partial R \geqq -\partial U/\partial C$.

In view of these points we are compelled to reject the "plausibility-of-values" criticism of our traditional model as irrelevant as well as technically unsound.

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DETERMINANTS AND DEVELOPMENT IMPLICATIONS OF FOODGRAIN PRICES IN INDIA: COMMENT

John W. Mellor and Ashok Dar in their article in this Journal [1] carried out a detailed empirical study of the relative movements of foodgrain prices and the determinants of those movements and observed that over 80 percent of the variations in foodgrain prices can be explained in terms of the variations in the gap between supply and demand and in the money supply. In this connection, we want to raise two points.

The first point is related to the impact of private stocks on prices. The authors have stated, "Although it is generally assumed that traders do not carry significant quantities of grains from one year to another, there is disagreement about whether farmers do so" [1, p. 968]. It is further stated ". . . that the farmers who produce the bulk of marketed supply have ample financial power to hold stocks, and that such storage may, at least in some years, be highly profitable" [1, p. 968].

It appears that the authors' assumption regarding the behavior of the traders does not seem to be tenable in the Indian situation. The relative impact on prices exerted by the stocks of the private traders is equally, if not more, important than the stocks held by the farmers. The private trade in foodgrains in India includes a multiplicity of operators between the consumer and the producer. The tendency for private enterprise to enter the trade where quick and high profits are realizable has been observed in India in foodgrains. This has merely inflated the cost by multiplying the stages of exchange between producers and consumers. The following two evidences support this view.

(1) The number of workers in food trade increased from 2.4 million in 1951 to 3.4 million in 1961 while its proportion to total workers increased from 2.46 percent to 2.65 percent, in contrast to the relative decline in number of workers in other sectors of trade and commerce [2, pp. 57, 63, 64].

(2) Total resources invested in foodgrain trade also increased in the decade 1951–61. The increased number of traders in foodgrains itself may be taken as an indication of increased resource investment in foodgrain trade. Resource investments from banks and other sources also increased in this period. In one study [3, p. 122] it was maintained that, in spite of actions to restrict advances against foodgrains during periods of increasing speculative foodgrain hoarding, the trend towards a relatively higher level of advances to traders has persisted. Also, sources other than bank advances are more important because the restrictions and checks against speculative hoarding are less effective. The large increase in volume of coop-

erative credit made available in the villages has been used to some extent to finance stocks, particulaarly in the case of paddy in South India [3, p. 122].

All this indicates that the stocks of foodgrains held by private traders are also of considerable significance in determining annual foodgrain prices. In the light of this, the policy implications suggested by Mellor and Dar [1, p. 970], especially the first two, would be more difficult, and their view that "in the longer run, a program of farmer education and collection and dissemination of accurate price and storage information would be helpful" [1, p. 970] may not prove to be so helpful.

A minor point, related to imports of foodgrains, also deserves attention. There cannot be any controversy over the role of the imports in maintaining the price level of foodgrains, but the absence of evidence of an upward trend in imports, as viewed by the authors, should not lead anybody to conclude that the dependence on imports has not risen in India. If we examine carefully the average yearly imports of foodgrains in three plans, it will be clear that over a period of fifteen years the dependence on imports in India, in absolute as well as relative terms, has increased. The estimates of average yearly net imports of foodgrains in the first, second, and third plans are 1.76 million, 3.87 million and 6.45 million tons, respectively, while the corresponding estimates of import as percent of net availability (from domestic production plus imports) are 2.96 percent, 5.57 percent, and 8.38 percent.

A further point may be relevant here. The authors have indicated that the expansion of money is no less a cause for rise in foodgrain prices. In fact, any sectoral price rise, by the same logic, can be traced to the expansion in money supply. In India, if money supply has influenced any set of prices, it is that of industrial raw material prices. The impact of expansion in money supply on foodgrain prices can be traced if one wishes, via the diffusion effect. But here all the prices are involved and foodgrain prices cannot be singled out, for such simple corelation between expansion in money supply and prices can be found with reference to other prices also.

To conclude, in India the whole problem of foodgrain prices rests on two factors: (1) distributive trade and (2) monsoons. If successively two or three monsoons are good, distributive pipelines would burst and foodgrain prices would practically crash. But as yet, India has not had this happy experience.

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DETERMINANTS AND DEVELOPMENT IMPLICATIONS OF FOOD GRAIN PRICES IN INDIA: REPLY

It should be clear from the text of our article [3] that we were not dealing directly with seasonal variations in prices but with year-to-year variations in prices. For this reason, we emphasize concern with carryover stock from one crop year to another. Stocks of foodgrains held by private traders within the crop year are substantial and undoubtedly fluctuate considerably from time to time within the year and from year to year. The implication of our statement, however, is that the private trade liquidates its stocks prior to harvest time. Indeed, this is clear from the quotation in the comment by Adhvaryu and Patel. This position is clearly documented in Uma J. Lele's extraordinarily detailed studies of foodgrains marketing in India [1, 4]. As the commentators point out, there has been an expansion of cooperative credit that has undoubtedly facilitated financing of stocks of foodgrains to be carried over from one year to another in the villages. That is, of course, fully consistent with our position. Of course, year-to-year changes in the pattern of seasonality will affect April prices. This we did not deal with and remains as a source of error. Its importance as a source of error is probably minimized in April.

In a country that has large fluctuations in production from year to year due to changes in weather, it is difficult to estimate trends in production. This difficulty will of course be magnified in dealing with the absolutely much smaller residual difference between domestic production and consumption represented by imports. Comparison of five-year averages for the first, second, and third five-year plans is particularly misleading because of the quite different proportion of good weather and bad weather years in these plans. Lele and I discussed this at length in [2]. Statistical analyses of weather data show clearly that the first five-year plan period averaged much better than normal weather, explaining the sharp drop in foodgrains imports in that period, as compared with the preceding periods, and the unjustified optimism concerning progress in the agricultural sector during the First Plan. The Third Plan period was characterized by much worse than average weather, its extraordinarily disastrous last year having a heavy influence on the average. The figures expressing imports as a percentage of production are particularly biased by these problems because in bad weather periods the imports will be larger in absolute terms and the base of total supply will tend to be somewhat smaller.

One can expect expansion in the money supply to affect all prices. Our point, however, is that the impact on foodgrains prices has been somewhat different from the effect on other prices. We point out at some length that care must be used in interpreting this figure.

The problem of foodgrain prices in India is much more complex than Adhvaryu and Patel make out in their last paragraph. My colleague and I deal with this at much greater length in [3]. Adhvaryu and Patel are of course correct in pointing out the special impact of a succession of good weather years. Contrary to their statement, India has indeed had such experiences, which we analyze statistically in our paper.

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EFFECTS OF NONPRICE VARIABLES UPON PARTICIPATION IN WATER-ORIENTED OUTDOOR RECREATION: COMMENT

There are basically three things wrong with the Gillespie and Brewer piece [2]: (1) the amount of explained variance reported, (2) the dependent variable, and (3) the handling of the intercorrelations and curvilinearity in the independent variables.

Taking the problems in reverse order, there are two acceptable ways of handling intercorrelations and curvilinearity. One is through the use of dummy variables, in which the intercorrelated variables are grouped together and the coefficients of the various dummies compared. If continuity must be maintained for some reason, it is also possible to include both a variable and a square, by using the square of the difference between the value of the variable as observed for a given individual and the mean of the variable for the sample as a whole. This squared term will not be correlated with the initial value of the variable.

The effect of using "number of visits" as a dependent variable is to give a person who made ten visits ten times the weight assigned to a person who visited only once. If the former had a higher income than the latter, this gives a great deal of weight to higher income people. If what you want to do is to predict the number of visits by some group or sub-group in the population, this is an appropriate statistic. If, instead, you want to find out whether or not lack of income prevents people from participating in outdoor recreation, this is not an appropriate dependent variable.

As to the R,^{2} I think it is grossly in error Analyses of household survey data, the type Gillespie and Brewer apparently had, do not explain more than 15–20 percent of the variance using *their* kind of dependent variable [1, 3]. With a "grouped" or dummy dependent variable like that mentioned above, the R^2 can be expected to be as high as 30 percent [4, p. 27].

An alternative to their analysis of

Table 1. Estimates of parameters

Variable	Regression coefficients	t-ratio
Constant	2.71	5.10
Age 21–24	1.99	3.51
Age 25–34	1.93	4.11
Age 35–44	1.22	2.78
Age 45–54	.74	1.81
Age 55 and over, not retired	0	0
Age 55 and over, retired	.59	1.06
Income less than $3,000, all education groups, or		
Income $3,000–4,999, 0–8 years education	0	0
Income $3,000–4,999, 9+years education	1.25	2.49
Income $5,000–7,999, 0–8 years education	1.70	3.17
Income $5,000–7,999, 9–12 years education	1.96	4.35
Income $5,000–7,999, 13+years education	2.76	4.73
Income $8,000–9,999, 0–8 years education	1.38	1.90
Income $8,000–9,999, 9–12 years education	3.27	5.56
Income $8,000–9,999, 13+ years education	2.34	3.24
Income $10,000–14,999, 0–12 years education	2.06	3.80
Income $10,000–14,999, 13+years education	3.09	4.31
Income $15,000+, 0–12 years education	2.03	2.80
Income $15,0000, 13+ years education	2.36	3.08
Single women with children	−1.01	−1.73
Single women without children	−1.26	−3.13
Married adults, no children	0	0
Married women, any children, age 1–5	− .23	− .52
Married women, children, age 6–18	− .41	− .98
Married men, any children, age 1–5	1.02	2.34
Married men, children, age 6–18	.95	2.09
Single males	− .14	− .27
Work week less than 35 hours	− .94	−1.80
Work week 35–64 hours	0	0
Work week 65 hours or more	− .58	−1.06
Milwaukee, Madison	− .26	− .76
Other cities over 50,000	− .28	− .63
Cities 10,000–50,000	− .26	− .75
Cities 2,500–9,999	− .03	− .08
Unincorporated areas, under 2,500	− .47	−1.14
Unincorporated areas, not farms	0	0
Farmers	− .72	−1.57
Occupation: professional or managerial	− .19	− .44
$R^2 = .26$ N=758		

data is to change both the dependent and independent variables. I have done this for a sample of adults in Wisconsin. The regression is shown in Table 1. The dependent variable used a grouped activity index in which people were classified by frequency of participation, i.e., 0 = never; 1 = 1–4 times; or 2 = 5 or more times. (This kind of dummy dependent variable was also used by Mueller [4] and more extensively by Lansing [3].) These scores were summed for each of nine activities similar to those measured by Gillespie and Brewer.

The use of dummy independent variables makes a number of things possible. For example, income elasticities can be estimated that differ among education groups or over different ranges of income. Thus, it appears from the statistics in Table 1 that a single income elasticity for general participation in outdoor recreation is probably inappropriate. The elasticities will differ among education groups; elasticity also appears to differ over the income range. The difference between our approaches to the independent variables is that I am asking for the best fit for a subgroup of the population; they are asking for the best fit for the entire population. To isolate the effect of income and education, they give up two degrees of freedom by adding two parameters (education squared and "the product of income and age"), which invalidates their *t*-ratios and makes the effect of their coefficients more difficult to decipher. To do the same thing, I have added nine parameters and come up with a set of variables whose effect and significance is easy to observe.

Joe B. Stevens, in his comment [5, p. 193], alluded to a lack of significance of several of the variables. It is not possible to put both of the intercorrelated variables in the same regression without changing the regression coefficients and invalidating the *t*-ratios. For example, in an analysis using Gillespie and Brewer's model, but *my* data, the correlation between age and age squared is .985; between education and education squared, .979; and between income and "the product of income and age," .887. There seems no reason to suppose that these will differ very much with Gillespie and Brewer's data. In the regression using only two variables, income and age explained 10 percent of the variance. The coefficient for age was −.6547 with a *t*-ratio of −7.1203, highly significant. When the next regression was computed with income, age, and age squared, the coefficient for age was −.7064 but with a *t*-ratio of −1.31, while for age squared the coefficient was .00353 with a *t*-ratio of .097. Thus, with both age and its square in the regression, the *t*-ratios of both appear to be insignificant; yet the effect of age is, of course, significant.

It is hard to believe that the *determinants* of participation in outdoor recreation have a more consistent effect among people living in St. Louis than among those in Wisconsin and/or the nation. I am quite willing to believe that, on the average, people in Wisconsin participate more, just because of the ease of getting to the supply of outdoor recreation. This in fact, appears to be the case: the average in Wisconsin was 35.5 times, while in St. Louis it was 27.3. When my data was regressed using the dummy *independent* variables suggested above, but a linear *dependent* variable like Gillespie and Brewer's, the explained variance was about 15 percent, depending only slightly on the way the independent variables are treated. Running *my* data using *their* complete model again shows a low explained variance: $R^2 = .14$ (see Table 2). However, my data is for an entire state, in which only 30 percent of the population lives in a metropolitan area. If the people in St. Louis do behave more systematically than people throughout the nation generally, this is a most important finding and one that should be tested in other metropolitan regions. In fact, it has been tested in Detroit; but the findings for Detroit suggest that: (a) the determinants are similar to what I found in Wisconsin and what was found nationally, and (b) that we may expect a *lower* rather

Table 2. Estimates of parameters

Wisconsin data				Gillespie and Brewer (St. Louis) data			
Variable	Regression coefficient	t-ratio	Percent in Occupation	Variable	Regression coefficient	t-ratio	Percent in occupation
Income	.0009	.92		Income	−0.0015	−1.54	
Age	−.62	−1.03		Age	−0.076	−0.12	
Age squared	.0007	.13		Age squared	−0.0078	−1.23	
Product of income and age	.0031	.02		Product of income and age	+0.000068	+3.74	
Education	−.01	−.00		Education	−4.17	−2.38	
Education squared	.02	.22		Education squared	+0.22	+2.94 +2.94	
Female household head	−13.18	−3.00		Female household head	−5.86	−1.26	
				Non-white household head	−14.27	−3.13	
Occupation:				Occupation:			
Retired	−71.80	−1.80	11	Retired	+13.44		16
Professional	6.07	.43	9	Professional	−7.87	−3.03	11
Manager	−2.18	−.15	11	Administrative	−7.20	−3.22	14
Sales	−6.88	−.48	6	Technical	0.85	1.83	8
Crafts	−5.52	−.40	17				
Operatives	−1.16	−.08	18				
Service	1.02	.07	5	Service	−0.56	−2.42	21
Clerical	−3.88	−.28	12	Clerical	−7.43	−2.96	7
Laborer	−11.52	−.69	2	Laborer	6.55	1.34	16
Not in labor force	0	0	2	Housewife	6.89	0.88	6
Farmers	−18.87	−1.35	8	Unemployed	−4.67	−1.39	1

Constant term = 58.27
$R^2 = .136$
$N = 758$

Constant term = 53.5
$R^2 = .62$
$N = 1000$

than higher R^2 in metropolitan areas [3, p. 176–9].

In conclusion, while I think it is important to isolate the determinants of participation in outdoor recreation, this must be done so that the results reflect the underlying relationships. The Gillespie and Brewer model is inappropriate, if for no other reason than that it can mislead someone as sophisticated as Joe B. Stevens into thinking that the effect of age is *insignificantly* negatively related to participation rates.

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FEEDBACK FOR STUDENTS ON CLASS PERFORMANCE

Students have the right to know where they stand in their various classes—before the end of the term! A newly developed program at Purdue University called the Student Grade Report (SGR) does just that plus a lot more. This computerized system provides the instructor with an analysis of individual and class performance on which he can evaluate progress and eventually assign grades at the end of the term. The system results in more accuracy with considerably less effort than conventional grade books.

Students are the big winners. Each student receives a "print out" several times during the term that shows the official record of his scores, along with class averages for each item. The total weighted average is clearly calculated, and the student's class rank is shown. Also included is an anonymous list of the averages of all other students to show how much a student must improve to get a certain rank or grade.

"The SGR was a great motivating device for me!" reported one student. Another indicated that ". . . I really like knowing exactly where I stand." These comments are typical of the responses from students who were given Student Grade Reports by their instructors periodically throughout the semester.

Some 275 students in five different classes responded to a recent questionnaire about SGR. Results show that 88 percent felt that the SGR's were of high or very high value to them. More than 75 percent felt the system was "more accurate" than conventional grading systems, because they were sure of the scores recorded for them and could see the calculation of their averages. More than three-fourths of the students felt that SGR helped motivate them, while only 6 percent indicated any discouragement as a result of the reports. Students like to know where they stand. They like SGR.

Instructors like the Student Grade Reports, too. SGR provides the instructor with the same information given his students, but conveniently summarized for quick evaluation of group and individual performance. For example, the instructor will find raw scores converted to standard scores with a mean of 50 and a standard deviation of 10 to show relative performance. Student performance is summarized alphabetically as well as by seat number for easy reference. Of course, conventional raw scores are also shown.

The system is unusually flexible. Instructors are free to use any predetermined wighting system they wish. There can be up to five different types of scores (quizzes, term papers, exams, etc.), with up to fifteen of each. As many as several hundred students can be processed for a given class. SGR will accomodate excused absences; it will also drop the one or two lowest performances from each student's total score, if the instructor so desires. Additionally, it gives the instructor an analysis of excused absences, zeros, and missing work.

The SGR is simple to operate. After a class is "set up," only a few cards need to be punched prior to a summary. Clerical or student help seem to have little trouble with processing. Expenses for the system are minimal, with computer cost at five to ten cents per summary. The program is written in Fortran IV and is adaptable with little alteration to computers found on most campuses today.

During the spring semester, Purdue had about 1200 students in the School of Agriculture receiving SGR periodically. The system has been growing in popularity with the students and instructors. The advantages of quick feedback, motivation from "knowing where you stand," spotting troubled students early, convenient class evaluation, and accurate, fast analysis of performance in the hectic moments before grades are due are all reasons for this popularity.

And our students have a right to know!

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A NEW LOOK AT DEMAND ANALYSIS FOR BEEF: COMMENT

Uvacek, in a recent article in this Journal [3], hypothesized and attempted to prove that the cattle cycle was a demand shifter for beef. He concluded that annual adjustments in the demand for beef were due to changes in per capita income, while abrupt shifts in the demand for beef were due to production cycle alterations.

The validity of the theoretical argument presented by Uvacek is questionable. He assumes one demand curve during the build-up years of beef production cycle and a less elastic demand curve during the liquidation years of the cycle. Contemporary economic theory [2] usually theorizes that income, population, tastes and preferences, and prices of substitutes and complements are the demand shifters.

Agreeing with Uvacek that the traditional demand shifter income has caused the annual shifts in the demand for beef, it is possible to explain the less elastic demand during the liquidation years of the cattle cycle without theorizing that the cycle itself is a demand shifter. Uvacek states that the cattle cycle is positively correlated with slaughter levels [3, p. 1502]. However, the peaks and troughs of the production and slaughtering cycles do not coincide (Figure 1).

For the time period used by Uvacek, the slaughter cycle hits its bottom in one instance two years later and in another instance one year later than does the production cycle and hits its peak one year behind the peak of the production cycle. Thus, while the production cycle would show a decreased amount of beef available during the first year of liquidation in the beef production cycle, actually the supply of beef is increasing as shown by the slaughter cycle.

The larger supply during the beginning of the liquidation phase of the production cycle could shift the supply curve to the right. Assuming such a shift in the supply curve and a linear demand curve, the intersection with the demand curve would be further to the right and in a less elastic area of the demand curve. Thus, the less elastic or inelastic demand during the liquidation phase of the production cycle is not a shift in the demand

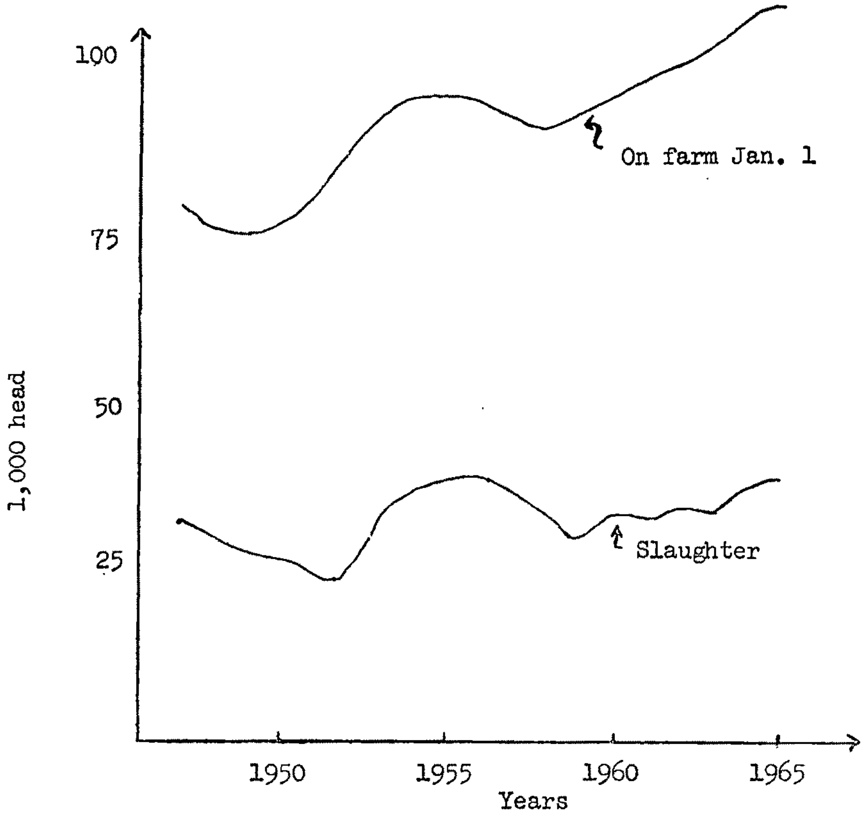

Figure 1. **Total number of cattle and calves on farm January 1 and slaughtered in the United States, 1947–1964**

curve but a change in the quantity demanded.

In addition to the questionable status of the theoretical argument presented by Uvacek, the methodology he employed to test his hypothesis lacks rigor. First, the coding system used for the dummy variable representing the production cycle in no way depicts the cycle (1 for 1947–48, 2 for 1949–1954, 3 for 1955–1957, 4 for 1959–1964, and 5 for 1965–1966). A 0,1 coding system, 0 for build-up years and 1 for liquidation years, would depict the trends of the cycle that Uvacek's coding system failed to do. Second, there does not exist any type of economic interpretation for the coefficient associated with the coded production cycle variable. It is difficult to assign economic significance to a sequence of discontinuous but equal downward shifts in the demand curve each time we move into a new phase of the cattle cycle, regardless of whether the new phase is one of expansion or contraction. Even more damaging is the lack of relationship between Uvacek's stated hypothesis and the statistical model postulated. Third, Uvacek previously accounted for the production cycle in his regression model with variable X_1 (beef production per person) and therefore lacked any economic or statistical reason for introducing the variable. In addition, there is a high degree of multicollinearity among Uvacek's independent variables.

The proper methodology for testing Uvacek's hypothesis of a different slope and intercept would be that outlined by Johnston [1, pp. 221–228].

Uvacek's equation in general terms would then be:

$$(1)\ Y = \alpha_1 + \alpha_2 X_9 + \beta_1 X_1 + \beta_2 X_6 + \beta_3 Z$$

where

$$(2)\ Z = X_9 X_1$$

and

$$X_9 = \begin{cases} 0 \text{ in each build-up year} \\ 1 \text{ in each liquidation year} \end{cases}$$

X_1 denotes the beef production per capita, as shown by Uvacek in his final model [3, p. 1505]; X_6 is disposable per capita income; X_9 is a 0,1 dummy variable depicting the phases of the slaughter cycle; and Y is the wholesale choice beef carcass price.

With equation (1), we have assumed a different intercept and slope for the build-up and liquidation years of the beef slaughter cycle, and therefore tests of significance on the proper coefficients would test for each, α_2 for the intercept and β_3 for the slope.

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A NEW LOOK AT DEMAND ANALYSIS FOR BEEF: REPLY

The criticism levelled at my recent article [3] by Folwell emphasizes two obvious factors: (1) All details of an analysis cannot be contained in a six-page contributed paper; and (2) it certainly pays to attend the sessions when such papers are presented. Many of the questions raised by Folwell were either offered in the actual presentation at the meetings or covered in the discussion period that followed. For the benefit of those who were unable to participate, let me specifically reply to the objections raised. Most references are to those publications previously cited in the reference list of the original article.

Fortunately, there are many in the profession who are constantly seeking answers beyond what contemporary economic theory can provide. Let us hope that contentment never completely settles in, and that we continue to experiment with new ideas and techniques.

Perhaps the basic ideas of my proposed demand shift concept were not fully understood. First, it is already recognized by many contemporary economists (such as Waugh and Working) that abrupt shifts in the demand for beef do actually exist. The real problem remaining is to identify the timing of these shifts. Secondly, per capita income changes no longer provide a full explanation for changes in the demand for meat, as emphasized by Working and Meinken. Elaborate details on other factors affecting the demand for meat can be found in such analysis as that provided by Holmes [2]. Thirdly, the basis for suggesting separate demand curves for each phase of the cattle cycle rests upon the concept that irreversible demand curves exist for beef, resulting in completely different curves during periods of increasing supplies versus supply reduction periods.

Contrary to Folwell's analysis, even though the peaks and troughs do not always coincide, the cattle numbers cycle, according to most statistical criteria, is highly related to cattle slaughter levels. Such graphic cohesiveness is hardly regarded as a requirement for a significant correlation. May I suggest that, when a comparison of the data for the years 1948 to 1967 is viewed on a semi-logarithmic scale and the correlation coefficient of .9447 is examined, the relationship becomes quite apparent. This relationship between numbers and slaughter, even though not perfect, is highly important since it is the cyclical changes in numbers that provide a "time element" to these demand shifts.

Any analysis of these two series, however, must recognize the fact that the cattle numbers estimate is a figure representing inventories as of the first of each year, while the slaughter level is the total kill during that calendar year. Complete comparability, therefore, may not be possible. The first year or so of the buildup of the cattle numbers cycle usually involves a holdback of cows for breeding, resulting in somewhat reduced slaughter and, therefore, an opposite reaction to the positive correlation. Similarly, the first year of the liquidation phase creates some problems since cow culling is severe and more are sold, temporarily forcing slaughter to slightly higher levels. In each case, however, the composition of total slaughter is changed. It is primarily the cow slaughter that decreases or increases and reacts opposite to the established cyclical relationship. The type of cattle killed during these critical years of the cattle cycle becomes of paramount importance to any analysis of beef demand.

Changes in yearly supplies of beef, provided by variations in the cycle, have been adequately explained by the rancher's reactions to price levels. Thus, they do represent shifts in supply curves. It has been pointed out that when both supply and demand curves shift, the analysis of consumption and supply data traces out what may look like a structural demand or supply curve, but with an extreme slope [1, pp. 53–56].

On the other hand, within a year, the quantity of beef is predetermined by the number of animals on farms and ranches as of the first of the year. Working emphasized that the measurement, through demand analysis, with such an almost verticle supply curve, yields an average demand curve. Even though economics and statistical theory lessen the significance of such a regression line compiled from such data, its usefulness in forecasting has been frequently proven.

As indicated in the first part of my

paper, the entire concept was offered to stimulate some new attempts at dealing with price prediction and was not meant to present an econometric analysis or explanation of the pricing system. This chore was not ignored, however, but rather relegated to a less significant contribution in my dissertation.

The coding system used to represent different phases of the cattle cycle was statistically tested for several months and through dozens of regression analyses before the final codes were accepted. The obvious 0,1 coding system suggested by Folwell was one of the first attempted but was discarded because it did not prove to be statistically significant and it assumed the economic interpretation that the buildup years of the cattle cycle could be consolidated and, therefore, that identical slopes exist during this same phase of each succeeding cycle. A similar consolidation of the liquidation years is inherent in the proposed code. However, graphic analysis indicated that the beef demand curves did not appear to have the same slopes and that, in fact, the demand curve during succeeding buildup phases was actually becoming more elastic.

The economic significance of the finally accepted coding system seems quite apparent. It implies that each phase of the cattle cycle must be studied separately, since a new demand curve may exist during each period. A cycle-time dummy variable was therefore introduced. It contains much more economic substantiation than an arbitrary division of the years under study into two or more equal periods, as frequently done in previous beef demand analyses. These researchers have implicitly assumed a different demand curve for each group of years.

The beef production per person variable is offered in my equation as a demand indicator, even though it is usually stated as a per capita consumption figure. The coded value also is derived from a production cycle and is offered as a demand indicator. Since Folwell had difficulty in grasping the economic significance of this coded demand indicator, it would seem that multicollinearity would be equally difficult to identify among the independent variables. The presence of serial correlation, however, was thoroughly examined and none of the tests was conclusive.

Interesting enough, the suggested procedure outline in Johnston was not attempted. It's economic interpretation, however, would have to mean that the demand curves during the buildup phases of the cycle are related, as are the curves during the liquidation periods. By utilizing the code twice, for example, the same slope and intercept is assumed for the 1949–54 and the 1958–64 data. My analysis emphasized, however, that separate demand curve slopes and intercepts exist for each phase of the cattle cycle and that the relationship between phases of succeeding cycles is only casual.

Demand analysis of beef, in the past, has been choked with the traditions of our profession, with the result that it was inadequate as a forecasting tool. Possibly this first attempt to add a dimension to the abrupt shifts in the demand curves for beef, if only a clumsy start, can stimulate a whole new era of enlightenment.

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THE UNSEEN—AND UNFEELING—HAND

Considering the alternative of having done nothing, I submit that we are fortunate to have had some of the inconsistent schemes and programs that we have in agriculture, such as:

1. Surpluses, with the experiment stations continuing to pour out cost-cutting and output-increasing innovations.
2. Surpluses, with the politicians getting more dams and irrigation projects set up so that there will always be more and more food and fiber production.
3. Acreage taken out of production to keep farmers alive in spite of 1 and 2 above.
4. Federal payments to planters not to plant, but not to their workers not to work.

We are fortunate because:

1. The world needs all the productive capacity and technology that have been developed for plentiful food to give energy to the world's finest resource, the people.
2. Things might have been worse in the United States without the programs; not considering the assurance of future food supplies here and abroad.
3. How do you have enough without having a surplus? This question was called to my attention by Professor Kohlmeyer. I think it is one that might be asked by everyone from, for example, Oren Lee Staley to the compilers of the 1967 Random House Unabridged Dictionary. Dare we define part of the U.S. agricultural produce as surplus when people hunger?
4. If farmers are to compete with corporate research and remain the managers of agriculture, they will need their publicly-owned research complex.

A grand foresight might have eased adjustments along the way. As Dean Acker of our institution has said, the tragic migrations of millions from agriculture to urban ghettos cried out for some sort of national policy on population distribution.[1]

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[1] Perhaps a United States Department of Human Ecology, cutting across rural and urban lines is our need. An effective national policy would face the question, not only of whether to encourage or discourage migration of "surplus" people, but also how and whether to help retain in agriculture or train or employ those who do not migrate as well as those who do. It should consider the impact and use of a guaranteed annual income to hold back the flood of migrants and to offset partially the need for cheap food. It could even consider influencing the rate of adoption of technology. Down the

We didn't hear in time; but if we survive that oversight, we are prepared for the more distant future. America's unrelenting pursual of agricultural research and development, although it filled our ghettos and caused untold misery, is the world's insurance against future hunger.

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road, it would hope to anticipate potential surpluses and deficits of people and be able to prevent their development.

REGIONAL RESEARCH—FURTHER ANALYSES AND REFLECTIONS[*]

Regional research provided for by legislative act has been with us since 1946. In this 23-year span, there has been little unanimity of agreement as to what procedures would give a satisfactory and productive program.

One of the most comprehensive articles to be published on regional research recently appeared in this Journal [1]. It reviewed the apparent weaknesses and many dissatisfactions with the program and offered some suggestions for possible improvement. The authors—Harris and Hildreth—made objective and comprehensive analyses that provide a basis for comments and dialogue among those who are closely associated with the program.

I shall first summarize the problems listed by the authors and analyze the suggestions made by them and thereafter present what I consider to be the key elements for achieving improvement.

Characteristics and Problems of Regional Research

The following characteristics of regional research were cited as obstacles to the development of effective cooperative regional research: (1) a large proportion of umbrella-type projects, which results in grouping of unrelated state activities; (2) the predominance of state and local viewpoints of administrators and researchers; (3) committees that are too large for effective cooperation; (4) insufficient time allowed for the planning process; (5) absence of centralized leadership and staff for implementation, coordination and report writing; and (6) the low regard in which regional research is held by the more able researchers. There can be little disagreement with this list of problems. This characterization of regional research and the problems of its administration are real and evident to anyone involved in the program.

Other problems noted were: (1) that regional research requires excessive paper work in getting approval and in preparing the annual progress reports; (2) that regional research is not undertaken until the problem is in full bloom; and (3) that the results of technical research are not adapted and interpreted to non-technicians. These problems relate to all research and should not be enumerated as particularly characterizing regional research.

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[*] The opinions expressed are those of the author and may not represent those of the Cooperative State Research Service of the U.S. Department of Agriculture.

An Analysis of Their Suggestions, and Alternatives

Harris and Hildreth say that their suggestions for improvement may have been considered from time to time and that the complexity of the problems associated with the committee system does not permit a single prescription for improvement. I shall discuss each of their suggestions.

1. It was suggested that CSRS prepare a periodic analytical report on regional research that would give the status of the program and the underlying philosophy, objectives, and procedures, and that these be suitable to the needs of individual researchers on all regional research projects. This might be a useful exercise, but I believe such reports would be too generalized to help the specialized researcher. Opinions on what is productive regional research are now so varied that it would be difficult to lift up examples for illustration.

2. It was suggested that regional research funds be used to expedite development of intellectual resources through providing opportunity for station and USDA personnel to meet and discuss research problems of mutual interest. This is now possible, if it relates to regional research planning, as CSRS has recently developed procedures that permit use of regional research funds for payment of travel costs to such meetings, without the prerequisite of a specific project outline for that research.

3. Another suggestion was for experimentation with a broad program of research for a regional committiee rather than a project on a narrowly defined problem. In my opinion, adoption of this idea would do little more than divide the regional research funds among disciplines without knowing what the researchers propose to do.

We have *de facto* program committees now in the many umbrella-type regional projects under way, but this was not the intended purpose of the regional program. A better way to exchange ideas, develop theories and concepts, and stimulate intellectual development would be to encourage establishment of seminar-type research committees, similar to the Farm Foundation committees and other committees in the North Central Region. Such groups do not pretend to work on specific regional projects, but individual members initiate State projects on their own. Occasionally topics are spun off for development into cooperative regional research projects.

4. The suggested employment of a coordinator as an executive for the regional committee is already an approved practice and several committees have had and now have such a person. A coordinator can be effective if the problem and research plan lend themselves to central direction and operation and give him opportunity for intellectual leadership. I would conclude that a coordinator is fine under certain circumstances, but as a general rule this idea will not lift regional research to higher accomplishment.

5. Use of a research center to carry on the work for a regional project has been a practice since the early years of regional research. It is a particularly good idea for new plant introduction, study of poultry and animal diseases, and similar projects requiring a large investment in physical resources. The practice should not be overextended; such centers have a way of becoming more or less independent institutions and would drain away funds intended for the States.

6. That fewer members would make a stronger and more effective research committee has often been expressed and is generally agreed to be a desirable policy. While small committees might produce more regional projects, it seems certain that each could be a real cooperative effort and thus more effective. The idea of having fewer States involved in a regional project usually gets stymied in the project approval process, because an original proposal with few intended cooperators tends to be interpreted as a subject of little interest.

In addition to the above suggestions, Harris and Hildreth presented two general alternatives: (1) that regional research be supported only from the regional research fund, or (2) that the regional research system be dismantled.

With only one source of funds for regional research, the directors and other concerned administrators might be more likely to look at problems from a regional viewpoint in the project review and appraisal process. At present, regional, regular Hatch, and non-Federal funds are all used to finance a single project, thus tending to blend the programs as well as the funds.

Dismantling of the system entirely would necessitate changing the law to eliminate the regional research feature of the Hatch Act. Nothing so drastic is needed, for the law states: "Not more than 25 percentum shall be allotted to the States for cooperative research in which two or more State agricultural experiment stations are cooperating to solve problems that concern the agriculture of more than one State." A literal interpretation of this provision means that it intended administrative discretion to be used in determining what funds were needed for regional research, up to a limit of 25 percent (of the amount that represents the increases since 1946). The legislation seems thus to have provided for a system whereby the regional research would be developed according to needs, with allowance for discretion as to the amount of funds assigned thereto, up to the 25 percent limit. Apparently, it was not intended that a given fixed percentage be assigned to regional research, regardless of needs.

Two Basic Elements Need Consideration

The article by Harris and Hildreth is well done and comprehensive. However, I contend that it did not specifically bring to light the crucial and primary obstacles, nor did the recommendations zero in on the key elements basic to a satisfactory program. In my opinion, two basic elements are essential for successful regional research: (1) an adequate planning period, so that researchers accustomed to the individualistic approach will have adequate time to develop concepts, an understanding of the problem, agreement on what is relevant, and agreement on scope and methodology; and (2) a regional research program that is distinctive and separate from the total agricultural experiment station research program, rather than a blend and indistinguishable part of it. These points are mentioned by Harris and Hildreth, but apparently are considered to be merely on a par with other obstacles and alternatives. My contention is that the entire structure of regional research is dependent upon the extent to which these two elements are recognized and dealt with. All other elements or problems are secondary or merely symptoms.

Adequate time for planning

The research specialists selected for a regional research committee participate voluntarily, and no one has authority over anyone else. Furthermore, each committee member is a capable and independent thinker and sees a problem in the light of his own experience. In addition, each committee member is already busy and concerned with making his own significant contribution in his own area of research on his own campus, where he is responsible to his own administrators for recognition and advancement. Because of this distinctive situation, it is essential that there be considerable lead time before a specific project outline is prepared.

For the development of a significant cooperative regional research project, two or three seminars are needed to enable committee members to agree on the nature of the problem, to develop concepts and theories, and to agree on the procedures and research approach. This will take time and should be approached from the general to the specific. Seminars must be purposeful and held with the idea that a cooperative regional effort is to be undertaken. It is assumed that a wide-ranging exploration of a general field is not the responsibility of this type of planning group. The general problem area has already been identified and the seminars should deal specifically with the named problem area as to the present state of knowledge and further research needs. It is possible that a group might decide that sufficient knowledge already exists or that other research areas have higher priority for use of time and other resources. If the committee concludes that further research is needed and has high priority, it should move to the next phase of project planning. Before the research can get underway, the individual committee members must complete other unfinished projects, recruit graduate students, and make other administrative arrangements for initiating the new research.

The administrative advisor and the CSRS representative should inform the planning group whether they believe the proposal being developed would be acceptable as a cooperative regional project. These two in turn need to have standard guides as to what constitutes cooperative research effort on a problem that cannot be handled satisfactorily in a single state. Uniform and consistent standards and adequate time for planning are needed to prevent regional projects from merely being a collection of uncoordinated state projects.

Regional research—a separate program

The second point for improvement of procedures and policies for regional research involves handling its financing in such a way as to facilitate its development as a distinct program—one that is different from other segments of the agricultural research program. The difference should be due to the nature of the problem in that it is of concern to more than one State and requires coordinated and cooperative effort. At present there is a tendency to distribute the regional funds to all disciplines and research areas without prior study of what problems or phases of problems need cooperative effort.

One way of building a regional research program would be to decide first what areas to include and then to finance these with regional funds only.

This would have the effect of reducing the number of regional projects. Blending of all sources of funds possibly increases administrative flexibility, but it weakens the opportunities of adhering to agreed upon standards of differentiation. If high and uniform standards are followed in accepting areas of research for use of regional research funds, it is likely that the program could be substantially reduced and that less than the permissible amount of funds would be needed. This would permit distribution of the excess on the basis of the regular Hatch formula.

Researchers must do their part in making effective use of the regional funds. They must make specific commitments to carry out certain responsibilities and set forth the resource needs. Research workers will be able to do this if sufficient time is provided for planning among themselves and for communication with their administrators—department heads and station directors. In addition, standards as to what is acceptable as a regional effort and what constitutes cooperative effort must be uniform for all committees and all disciplines. If this is not done, the entire system may regress to competition for leniency, making the main concern that of getting the project approved so that one's fellow workers will be certain to "get their share of the funds."

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"SUBSISTENCE AGRICULTURE" AND TECHNOLOGICAL CHANGE: FURTHER DISSCUSSION OF THE THEORETICAL PROBLEM

A recent and most useful addition to the literature on "subsistence agriculture" has been provided by Dr. Marvin Miracle in this Journal [1]. The Miracle article has been the catalyst in the decision to write this note, ideas for which have been "brewing" for some time. Few of the ideas, if any, are new to the literature; but they are here brought to bear in a relatively new form, I think, on the analytical and theoretical formulation of the concept of subsistence.

The economist interested in the rural economic development of low output nations must center his attention on the basic issue of production. Agricultural development is the movement of a farmer or a herder, or a community, or a society, from a lower to a higher (and usually more secure) average level of productivity. Certainly, in the numerous projects in which I have been involved in parts of South America, the Near East, and Africa, the practical core issue is indisputably the movement toward a more efficient production technology. A great number of other things are usually necessary to achieve an improved technology: roads, better institutions for credit, marketing, farmer training, etc. But the underlying goal is an enhanced and/or more varied output. As I have said elsewhere [2, p. 9], the core of development "is *not* the transfer from no money to money, no exchange to exchange, no market to market, though these institutional mechanics may attend the process."

An improved production system is the central development issue, regardless of the sector being examined. In developed or underdeveloped countries, in every line of economic activity, there is a spectrum with the least efficient at one end (the adder of columns of figures by hand; the back-carrier of goods over bush trails; the hand cultivator) and the relatively more efficient at the other (the calculating machine worker; the driver of a five-ton lorry carrying goods to market over a paved road; the tractor cultivator). The most ignorant and unskilled are at one end of the scale, using the least efficient technology and systems; the more skilled are at the other, interested in and capable of using more advanced technology [see 3, 4].

The normal fabric of "Western" economic theorizing regarding development is geared to the use of particular aspects of the institutional mechanics referred to above. Our development models divide economies and agricultural sectors into several pieces in terms of one or a number of these institutional mechanics (dual economy development theory, for example). The no money/money dichotomy, the no investment/investment dichotomy, the rural/urban dichotomy, the no market/market dichotomy, the nonindustrial/industrial dichotomy: all these ways of looking at and attempting to posit the development issue are non-exclusive and non-scientific. Most importantly, they do not concentrate on the real source and nature of development. The heart of that matter is technological change.

The attempt to work with the concept of subsistence has been partly caught up, I think, in this general misdirection of our theorizing; we are trying gamely, as a profession interested in our theory, to work our way out of the theoretical box we find ourselves in. We *know*, from our collective practical experience, that agricultural change comes with improved systems of production. We *know*, as a matter of record and experience, everywhere, that this essential improved technology requires more motivated, skilled, and capable farmers. Yet we are theoretically nervous because we also know that the theoretical tools provided by our discipline are inadequate to handle this basic knowledge, these fundamental *facts* of development in the high *or* low output agricultural communities.

As Miracle indicates (also Wharton, Mellor, Johnston, and others), there are several general meanings of the word subsistence, including particularly the level of consumption of the farming or herding family, the proportion of the output that is marketed, and the percent of total family or community income that is money. I would submit that to use the term in these senses is utterly misleading, at least for policy and for theory. The development policy implication of these interpretations into which our theorizing has led us is that of concentrating on "monetizing" these rural economies by increasing the share marketed.

We are thereby side-stepping the key point on which we should be concentrating—technological change—and simultaneously dealing only with the edges and some of the characteristics of change, not the root causes that give us sustained rural development over the medium and longer runs. Adam Smith tells us to extend the market to obtain specialization of production and increased productivity. That is fine, but we have to have something to market, and that comes from a constantly improving production system.

Certainly, wherever I have been involved with practical rural development projects or conducting research, I have encountered examples of situations in which the percentage marketed is going up, while productivity and the standard of living are simultaneously going down. Conversely, I continually examine cases where the standard of real per capita output and consumption is rising, although the percentage of production marketed is declining.

I have studied and worked with examples of the former in central Sudan, in the Khuzestan (Iran), in numerous Indian communities of Colombia north of Bogota, in Kenya and Malawi, in Tanzania and Uganda, in (what is now) Biafra, and in the Ivory Coast. The usual pattern reflects a falling total output per capita due to declining soil fertility, smaller farm size, erosion, etc. The non-food cash needs, as well as the cash needs for food purchase in some cases, require that a roughly constant or even rising absolute volume of output be sold; this is a progressively larger *share* of a falling total output, and per capita food supplies fall, often rather quickly. The livestock societies in the Near East and Africa experience a similar process. I cannot speak for everywhere, not having been everywhere, but in those places where I have been involved, on the ground, this is a rather common experience.

Conversely, there are numerous examples of improvements in the system of husbandry and technology of food crop production leading to striking changes in the volume and diversity of food crops available. More might be sold, but sometimes a greater percentage is consumed. Often the change in food crop production technology is greater than the change in crops grown for cash sale, especially where this occurs after the cash cropping systems are well established. Consequently, at a higher overall level of farm output and living standards, one has "regressed" more toward a subsistence level in which the *proportion* of output being sold is lower! This situation is particularly common where appropriate fertilizers and seed strains are being used effectively to improve food crop production systems. This, too, is a very general development experience, and the opposite of one of the more popular meanings of subsistence.

It is legitimate to ask if we even need the concept of subsistence at all. We do need it, definitely, if we accept the idea that monetization and marketing are the "guts" of the development process. If they are *not*, the usefulness of the concept is severely emasculated for theoretical purposes; we are on side roads, not the highway. This observer's total experience says that they are *not* the "guts", but that technology and its changes as they affect the production process are indeed the real stuff of development. This is not to deny that improved marketing and related facilities, land reform sometimes, etc., are not critically important pieces of an overall package of inducements to change; they usually are—they permit, like roads. But permit what? More and improved production, which is what we are after.

If we accept this as a reasonable proposition, then we must, of course, be ready to cope with the consequences of that acceptance on our entire theoretical structure. I certainly have not thought it all out, though I have made some hesitant beginnings. If it is true that we really should be formulating development theories geared to a technological spectrum, as distinct from these others, what happens to all of our macro and sector development models that also are based on these related but tangential factors (instead of technological variables of some kind)?

I am not claiming to be correct in all this. Far from it: I am groping in the intellectual dark. But I do know what I see. And I know what my economic theorizing tells me. And I cannot make the two live together.

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SOME THOUGHTS ON BARGAINING

Bargaining is being mentioned with increasing fervor as a possible means of gaining higher prices and, hopefully, higher incomes for agriculture. Before bargaining can effectively raise prices, the supply of the product in question must be controlled. Although rigid supply control is not impossible, it would be a difficult accomplishment for commodities produced over wide geographical areas—the situation that exists for most of our major agricultural commodities. Whether a majority of farmers can, or will, band together in an effective bargaining group remains to be seen.

Asuming that farmers will stick together and effectively control the supply of a product marketed, how will the problem of product substitutes be handled? It is undeniable that when we raise prices for agricultural products, by whatever means, we openly invite competition from product substitutes. In many instances, while pursuing higher farm prices, we have already lost large segments of markets that formerly belonged totally to agricultural products. It is true that people must continue to eat, but there is no guarantee that the foods will continue to be demanded in their present form (e.g., cow's milk, beef steak, etc.), that they will be domestically produced (products made from foreign soybeans might taste just as good), or that they will even be agricultural products at all (e.g., artificial sweeteners).

Many propose that agricultural producers be given protection by outlawing the sale of some substitutes or by instituting such rigid marketing or labeling requirements as to make the cost of substitutes prohibitive. Others would readily deal with foreign competition that might threaten higher U.S. domestic food prices by instituting rigid import restrictions. Such restrictions may achieve the desired objective of particular groups of producers in the short run. However, the opposite side of the import restrictions coin is a loss of export sales—a high price to pay when agricultural producers are hopefully looking for foreign markets for additional outlets for larger portions of major agricultural crops.

Farmers alone cannot expect to secure legislation needed to restrict competition from substitute food and fiber products even in the unlikely event that all the many diverse types of farmers act in concert. Could they depend on help from urban consumers to pass legislation to make bargaining work? Successful bargaining would clearly mean higher retail prices. The nationwide demonstrations of housewives in response to hikes in retail food prices may provide a clue to the answer.

In 1968 taxpayers' generosity increased net farm income by $3.1 billion, or 28 percent, through government payments to farmers alone. It has been estimated that the other types of subsidies to farmers may contribute as much as another 25 percent to farmers' profits. Would consumers be willing to continue this expenditure to help agriculture and at the same time help farmers institute effective bargaining that would raise retail prices? Probably not. In fact, efforts on the part of farmers to force consumers to pay higher prices for food could result in a loss of the substantial public assistance now received to defray production and marketing costs. The willingness of the American public to finance agricultural research and education to insure a plentiful supply of food at reasonable prices has been the very root system of the success of our economy. Although consumers are the prime beneficiaries of these expenditures in the long run, the funds have been provided in the belief that they primarily aid agriculture.

The kind of bargaining that results in processors paying equal prices for equal quality to farmers in all locations (excepting transportation differentials) can be extremely beneficial for all concerned. But bargaining that forces processors and consumers to pay higher prices by reducing supply is an entirely different matter. Would the gains from "muscle bargaining" be sufficient to offset the possible loss of substantial income supplements farmers already receive through the generosity and good will of taxpayers? Would it be that subsidized agriculture is now in a position when it should ask: Do farmers really want to bite the hands that feed them?

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CALORIC COST OF RICE AND WHEAT PROGRAMS[*]

A question that often faces those concerned with federal programs for farm commodities is government costs. An official of the U.S. Department of Agriculture, for example, in May of 1965 in his opening statement to a Congressional committee declared that the question to be considered was “how to reduce the costs of the rice program to bring it somewhere comparable with costs of other commodity programs” [4, p. 6]. The official was thinking in terms of government costs per acre (Table 1). Should programs emphasize one commodity rather than another simply because government cost per acre is more for the latter? An alternative and useful method of comparing government program costs for certain commodities can also be obtained on a caloric basis.

The 49,313,000 acres of wheat harvested in the United States in 1965 produced an average of 1,614 pounds per acre, while the 1,793,000 acres of rough rice harvested produced an average of 4,291 pounds per acre [3, pp. 30 and 68].[1] A pound of whole wheat contains about 1,497 calories; a pound of brown rice, 1,633 calories [5, pp. 108 and 120]. To convert rough rice to brown rice, the hulls—about 17 percent of the weight must be removed [1, p. 2]. Thus, a pound of rough rice contains about 1,356 calories.

When viewed in this light, government program costs for the 1965 crop were 1.84 cents per 1,000 calories of wheat produced and 1.12 cents per

Table 1. Government program costs for rice and wheat, 1966

Cost items[a]	Cost per acre		Cost per 1,000 calories	
	Rice	Wheat	Rice	Wheat
	dollars		cents	
Price support, net realized loss[b]	7.21	4.30	.12	.18
Commodity export, net loss	23.64	3.24	.41	.13
Public Law 480, Title I	31.13	19.80	.54	.82
Public Law 480, Title II	—	2.58	—	.11
Public Law 480, Title IV	3.43	4.10	.06	.17
Diversion payments[c]	—	.77	—	.03
Certificate program	—	9.67	—	.40
International wheat agreement	—	.21	—	.01
Total	65.42	44.54	1.12	1.84

[a] Among government costs not included are overhead, soil bank payments, and certain ocean transportation on foreign donations.

[b] Includes program as reported and interest in the amount of $196,000 for rice and $39,545,000 for wheat as estimated by the writers at 4 percent on the average investment in CCC grain.

[c] Includes $12,000 loss from the 1962 and 1963 Wheat Stabilization Programs.

Source: [2], except where otherwise noted.

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[*] We acknowledge with gratitude comments and suggestions from Dr. Harvye F. Lewis and Dr. Shiang Ping Yang, both professors of home economics at Louisiana State University in Baton Rouge.

[1] Wheat production was converted from bushels to pounds at the rate of 60 pounds per bushel.

1,000 calories for rice—about 64 percent greater for wheat than for rice.

At present, government programs for rice are much simpler than for wheat. Rice has no cost in diversion payments, the certificate program, the International Wheat Agreement or Public Law 480, Title II, whereas costs to the government for wheat under these programs amount to .555 cents per 1,000 calories.

Wheat and rice are both involved in the price support program, the commodity export program, and Public Law 480, Titles I and IV. On a per calorie basis, program costs for wheat exceed that for rice in every case except the commodity export program.

Some may contend that the certificate program is not a cost to the government since a tax ultimately paid by consumers was simultaneously imposed at the beginning of this program to recover its cost to the government. If this program were eliminated from the above analysis, however, government costs for wheat would still amount to 1.44 cents per 1,000 calories compared to 1.12 cents for rice.

It is conceivable that some of the costs should not have been allocated to wheat and rice in the first place. Food for peace, repayments by recipient countries under Public Law 480 sales, maintenance of employment in the agribusiness sector of the economy, a favorable balance of payments position, maintenance of farm income and lowering prices to consumers are also important objectives of government programs. To the extent that costs are already being or will eventually be recovered through these objectives, they should not be allocated to the commodities. Further analysis is needed on these points.

Another question that might be raised concerns the desirability of various commodities. Meat, for example, is more desired, and people are generally willing to pay more for it than for other sources of protein. Similarly, rice is highly prized by many people throughout the world as a quality source of protein and for other reasons.

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MILK PRODUCTION AND UTILIZATION IN THE EAST

Prospects Ahead for Milk Production

Milk production is really a mixed-up picture in the East today. There are four states in this group of 13 where milk production is declining sharply: Rhode Island, Delaware, West Virginia and New Jersey. Milk production in these 4 states combined dropped 17 percent between 1960 and 1965 and another 17.8 percent between 1965 and 1968. The drop last year, in one year, was 6.7 percent. Production in these four states represented 5.5 percent of the total milk supply in the East in 1968, compared with 8 percent in 1960. The primary causes for these declines in West Virginia undoubtedly include the difficulty of putting together enough top grade land in a contiguous area to make a dairy farm enterprise of the efficient scale required today. In the other three states, urbanization is pushing land values beyond the point where one can afford to grow roughage. Concentrates can be imported but manure must be combined with roughage. Low unemployment creates farm labor problems as well as excellent opportunities for the dairy operator to change jobs. I can see no reason to expect milk production declines in these four states to slow down very much.

Maine and Massachusetts, with a combined milk supply in 1968 of about 5 percent of the East's total, have shown a decline of 10.8 percent since 1965. Both states may well show further declines in production, especially if the pending milk control legislative developments turn out unfavorably in terms of price. Maine has the smallest dairy farms in New England, and Massachusetts should soon be feeling the pressure of urban land values that has already hit Rhode Island and New Jersey.

Connecticut, with 2.6 percent of the East's milk production, has had excellent milk prices and has some excellent dairy land. Its production has held up very well so far. Connecticut has a population density of over 600 per square mile (next highest after Rhode Island, New Jersey, and Massachusetts), and excellent employment opportunities. Also, its high milk prices—72 cents per hundred-weight above New Jersey in 1967—may be affected by the pending United States Supreme Court case on nearby farm location differentials under Federal orders.

New Hampshire's production, although only 1.4 percent of the East's total, has also held up well. A couple of more good ski seasons like the past one, however, and a continued growth in the vacation-home trend could help start a big climb in land values and a milk production decline in this state.

The other five states—New York, Pennsylvania, Vermont, Maryland, and Virginia—are the big dairy states in the East, with 85.5 percent of the area's 1968 milk production. These states have lost a lot of small dairy farms in recent years, and they have serious farm labor problems. But their main dairy areas have not felt the urban land value pressure as much as other states in the East.

Let us suppose that the eight small states in the East continue to decline in milk production at the rate they did between 1967 and 1968—about 4.42 percent or 175 million pounds of milk. The big five would have to show an increase of about 8/10ths of 1 percent in order to make this up. Instead, the five big states themselves showed a drop in milk production of 1.85 percent from 1967 to 1968, or 420 million pounds. Milk prices are good in these states in relation to feed prices. As long as unemployment is so low, the farm labor problem will remain serious. One hesitates to suggest that milk production may start to show increases again. Given a little longer range, with unemployment at 4.5 to 5.0 percent instead of 3.3, the big 5 states could make up the decline in the smaller states.

Utilization Changes Ahead

How about prospective changes in the utilization of the milk supply in the East? There are definitely three developments on the horizon in the East that are not good news for the butter industry. First, the fluid whole milk in the area, based on data available from the five major federal order areas, is still generally 3.55 percent milk or higher. Outside of the South and the West Coast, most of the other Federal orders show a prevailing fat test of 3.40 to 3.45, and below 3.4 in several cases. The East could certainly move its whole milk test down to 3.5 relatively soon. If this were done with no change in the farm test, it would release 8,050,000 pounds of butterfat or roughly 10 million pounds of butter.

Second, the major milk markets in the East have not yet moved nearly so much into low-fat and skim items as markets in other sections, but they are headed that way. The March 1969 Fluid Milk and Cream Report shows for 1968 that, for the five eastern Federal orders referred to above, the low-fat and skim items were only 8.6 percent of the combined sales of these items and whole milk. In the other 65 markets in this tabulation, the low-fat and skim items were 17.5 percent of the combined total.

Hopefully, some of this low-fat sales volume is new sales, but certainly a big share of it is not. In these five major Federal order areas (Washington, D.C. area, Baltimore area, Philadelphia area, Connecticut, and the Massachusetts-Rhode Island-New Hampshire area) sales of the low-fat items were up 237,000 pounds per day in 1968 over 1967, while whole milk sales were down in these markets 150,000 pounds per day.

Every 5 percent of our whole milk sales volume in the East that moves from 3.5 percent milk to 1.0 percent milk represents a release of 20,125,000 pounds of butterfat that will probably wind up in the churn. Changes of this proportion, or much greater, are definitely in the wind.

Third, the excellent fluid cream sales volume we have enjoyed for so many years in the East, while still almost unbelievably high in relation to other sections, is declining sharply. But non-butterfat substitutes and diets are still hurting. The sales volume of cream and half-and-half in the five big Eastern Federal areas in 1967 was 2.6 percent of the combined volume of whole milk and low-fat items, compared with only 2.0 percent in the other 64 market areas reported. Actually the difference is much greater than this on a butterfat basis because in these Eastern markets 65 percent of the volume was cream and 35 percent half-and-half, while the proportions were almost reversed in the other 64 market areas in this tabulation.

The main point is, however, that the 1967 to 1968 decline in the five Eastern areas for these cream and half-and-half items was 6.8 percent compared with 3 percent in the other

64 market areas. A decline of 7 percent in the amount of milk needed to produce the fluid cream and half and-half sales in the East releases about 5,000,000 pounds of butterfat per year for the churn.

There is every hope in the East that the need of butterfat for ice cream will be going up about 3 percent per year. This could just about offset the decline in the butterfat needed for fluid cream sales. However, this still leaves 28,175,000 pounds of butterfat released by fluid milk developments.

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Reviews are listed alphabetically by authors.

Reviews

Dunbier, Roger, *The Sonoran Desert: Its Geography, Economy, and People*, Tucson, The University of Arizona Press, 1968, xiii + 426 pp. ($10.00)

Although the title of this book suggests a regional study, the author warns us at the start that "no attempt is made to show any overriding unity at work, geographical or otherwise. . . ." Here lies the work's main weakness: How can one write the geography, economy, and ethnology of a nonregion? This paradox is never resolved. Instead, the study is organized around two themes: that of man in relation to the physical environment of the desert; and, by contrasting modern southwestern United States with northwestern Mexico, that of the desert in relation to the social environment of man. Dunbier eventually defines his desert as the biotic province outlined by Shreve in 1951 (*Vegetation of the Sonoran Desert*) but extends it to include the coastal valleys south to the Río Culiacán.

In the development of the first theme, enough information is presented on landforms, climate, soils, vegetation, and water (chapters 1–5), and Indian, Spanish, and Anglo-American settlement (chapters 6–8) to fill in the geography and early economies for anyone not familiar with this part of the world. The emphasis here is on adaptation to, and exploitation of, the desert by the various groups that found themselves its willing or reluctant occupants. The section on vegetation provides a real feeling for the various communities, as well as all the common and Latin plant names.

A transition chapter on water resource development advances us to the period of massive environmental modification. Modern man does not adjust to the desert; he demolishes large parts of it by spreading water over thousands of acres and into densely populated cities and thirsty factories. Dunbier almost overdoes the data: a seemingly unending parade of river discharges, reservoir capacities, and irrigated acreages numbs the brain but does drive home the magnitude of change. Not just modification, but transformation! What is a desert with water? It is no longer a desert; so orchards bloom, cities spread, and populations multiply. The point is well made that in the desert it is not the land but the water that has value. And while some warn of future shortages, dwindling streamflows, and lowering water tables, is not the evidence that engineering will prevail?

The second theme is that modern landscapes cannot be explained in terms of local man-land relationships but must be viewed within the context of the larger societies that exercise political and economic control over them. Neither cotton from the irrigated fields of Sinaola nor electronics parts from the air-conditioned factories of Phoenix are possible or make sense without reference to the cultures that create first the demand for the products and then the physical environment in which they can be produced. The politically divided Sonora Desert makes an ideal laboratory for comparison. Following a long history of similar experience, sharp differences have developed on either side of the modern border due to the different rates of economic growth of Mexico and the United States. The respective cattle industries provide striking contrasts in organization and orientation. The sequence from native to Mexican to American economies (chapters 10-12) is a natural progression of increasing technological complexity and decreasing reliance on indigenous resources.

Chapter 13 on political factors takes a quick look at the fascinating border itself, "where the developed meets the underdeveloped world," and at the border towns with their unique functions and morphology. A short summary here should have ended the book; the final chapter on patterns of settlement adds little and is something of an anticlimax.

Technically the work leaves much to be desired. It is wordy and often redundant. Footnotes are excessive and inconsistent Maps lack geographic coordinates and scale. Dunbier does not appear to have personally inspected the nooks and crannies of either the desert or the archives: except for some government reports and published traveler's journals, there are few primary references in the 300-plus bibliography. The theme of man and the desert land, therefore, rests largely on recapitulations of previous work.

Furthermore, the relationship of the southwest to the U.S. economy is much better explained than is that of the northwest to the Mexican economy. This is reflected in the imbalance of source material: fewer than 10 percent of the citations are in Spanish and, while many of the English works are excellent, they are mostly written by Yankees. Thus, while a contrast of the two societies is central to the second argument, the view is decidedly from the North.

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Hardin, Clifford M., ed., *Overcoming World Hunger*, Englewood Cliffs, New Jersey, Prentice Hall, 1969, xi + 177 pp. ($4.95 cloth, $1.95 paper)

Prepared before the editor became the Secretary of Agriculture, this book was background reading for the 34th American Assembly. As many readers will know, this unit of Columbia University selects important national and international issues and organizes a full three-day discussion program, bringing together a cross section of competent and interested participants. A number of regional Assemblies usually take place during the subsequent year, and this book serves these groups as well.

Obviously, having been developed as background papers, the book could be of major use in extension seminars and public policy discussions on international affairs and world food problems. It can be a key resource for such programs.

Following a brief introduction by the editor, four chapters constitute the book. Chapter I, by Frank Notestein, deals with population. Chapter II, by Don Paarlberg, discusses nutrition and food supply and the relative merits of trade versus national production. Chapter III, by J. George Harrar and Sterling Wortman, concentrates on methods by which food production can be increased. Chapter IV, by David E. Bell, Lowell S. Hardin, and F. F. Hill, gives attention to broad actions and policies by which population and food can be brought into balance, in the framework of the role and importance of foreign aid.

Competent and broad gauge professional and policy leaders, as these authors are, write competent and broad gauge monographs. For those already working in this area, the material is familiar. Only the measure of the authors' judgments on the future course of events will be of interest. For the non-specialist economist and agriculturist, the chapters are an excellent introduction and updating of food and population trends. A comprehensive picture is provided in less than 200 pages, including the view that food problems have the potential of being resolved, but only if broad, continuous effort is made across a spectrum of policies.

One weakness, relative to the purpose for which this book is designed, is the limited encouragement to further reading. The American Assembly does provide such lists to its participants; their inclusion would make the book more useful.

Chapter I is thoroughly competent. It reviews the methodology, presents the UN population projections, and discusses their validity. It presents and reviews action programs to reduce the birthrate. Notestein deals with a variety of relevant issues and, in appraising the prospects, insists that humanity must soon control its fecundity.

Chapter II is less tightly argued. Paarlberg shifts back and forth between the developed and the developing nations, which is sometimes confusing. He clearly states and supports the proposition that neither the problems nor the solutions can be stated simply. More attention than this reviewer deems appropriate is given to appraising P.L. 480, with too little on how income growth and its broader distribution can help resolve nutritional deficiencies. But Paarlberg emphasizes the need for increased national production.

Chapter III argues for an interdisciplinary approach in increasing the national production of food. True to the Rockefeller tradition, agricultural economics is virtually ignored. And much of the chapter describes and, by implication, prescribes the Rockefeller approach to expanding productivity. Accepting, as one must, that these programs did reverse the widespread pessimism of five years ago to cautious optimism, still these two leaders of the Foundation should be more aware than they appear to be of the new, though less onerous, problems that the increased productivity creates.

Chapter IV deals with the now necessary issues—why, how much, and in what way the United States and other developed nations should assist in supporting population control, agricultural expansion and economic growth. The discussion is relevant, responsible, competent, logical, but likely not to be persuasive to many members of Congress, unfortunately.

This little book fills a need for a single reference for the interested lay public. Extension economists will find it useful in many ways. Supplementing the text in a policy course, some students will start preparing for a term paper by reading part or all of this book. And the non-specialist will find in it reasons for cautious optimism that the Malthusian clouds could be cleared away.

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Homer, Sidney, Paul W. McCracken, James J. O'Leary, and Henry C. Wallich, with a preface by Herbert V. Prochnow, *The Five-Year Outlook for Interest Rates*, Chicago, Rand McNally & Company, 1968, x + 89 pp. ($5.95)

Interest rates are in the limelight and for good reason: Be they the U.S. Treasury or just plain dirt farmers, borrowers in mid-1969 are paying rates previously seen only during national crises—the Civil War and War of 1812. Persons who consequently find themselves wanting or having to know more about the history, determinants, and prospects of interest rates will find this collection of four papers timely and informative.

The book is somewhat unusual in that each paper treats exactly the same subject. The sponsor—The Graduate School of Banking at the University of Wisconsin—evidently relied upon the varied background of the authors (two are primarily academic economists and the other two are Wall Street money-market analysts) to impart a different emphasis and style to each analysis. But as one might expect, there is agreement on and thus much repetition of the important points. And if the sponsor also expected significantly different opinions on the outlook, he was disappointed. One reads four times that rates in 1973 will probably be near historically high levels. Since there is no controversy either in analysis or the conclusion, the prospective reader may appreciate a plan of attack to avoid tedium.

A historical perspective should first be acquired, and an excellent starting point is right at the beginning of the volume with Homer's section on "The record of the past." Here one learns of the five great cycles in rates since 1800 and is disabused of any notion that movement in rates is something new or that rates move only in one direction. Then, for a detailed examination of factors responsible for the postwar upswing, skip to O'Leary's treatment of "The trend of interest rates since World War II."

One is now ready for an analysis of factors that will determine the level of rates five years hence, and here I recommend the McCracken paper. He presents a lucid discussion of the major considerations within a supply-demand framework, with both supplies and demands for funds conceptualized as proportions of national income. On demand, he emphasizes that a high rate of capital investment will be necessary to create jobs and provide housing for the now-maturing postwar baby crop and that federal expenditures on social problems will likely absorb more funds. On the supply side, he documents a historically stable savings rate, notes that the large number of young households to be formed over the next few years will contribute less to supply than to demand, and believes that probable continued price inflation will discourage suppliers of funds by reducing the "real" rate of return. (He expects continued inflation to result from greater public emphasis on maintaining a relatively low unemployment rate, which requires the economy to operate with less slack.) If both demand and supply schedules are expressed as proportions of a growing national income, he sees the demand schedule shifting to the right while the supply schedule is stable or actually moves to the left. The result: a price of money "high even by standards of the postwar period."

For those who want an analysis that goes beyond these principal factors, Wallich provides discussion of the different types of capital spending, the role of expectations in the term structure of rates, the impact of balance-of-payments considerations, and the effect of ongoing structural changes in capital markets. The observations of Homer, the respected bond market analyst, cover some of the same topics in readable fashion. But do not read Homer for rigorous analysis. He takes a long look at future demand and supply, but concludes that "Alas for the forecaster who seeks an easy tool, the total of savings in any one year always equals the total investment." Apparently, the concept of supply and demand schedules is not a prerequisite for success on Wall Street.

The authors forecast continued high interest rates, but remember that they wrote in 1968, when rates were considerably lower than in mid-1969. In taking on assignments to discuss the five-year outlook, they by-and-large excused themselves from discussion of short-term cycles. However, it is evident they did not expect that accelerated price inflation would within six months result in severe Federal Reserve restraint on expansion of bank credit and the money supply. Even from the 1968 level of rates, O'Leary expected a short cyclical downturn following a Vietnam peace. Presumably, the recent sharp rise gives this potential downswing a greater probable range.

The shorter cycles may be important to individuals faced with capital outlay and refinancing decisions, but it is the trend that bears most significance for agriculture. In 1968, interest paid by the farm sector totaled $3.0 billion, more than double the amount seven years earlier. However, the interest charge rose only slightly faster than the total debt. Now, as the expanding debt total is also refinanced at higher rates, the rise in total interest costs will accelerate.

A continued high level of rates may have other effects as well. In recent years, farmers' savings have provided a historically low percentage of the funds employed for equipment and land purchases, with increase in debt providing a historically high proportion. High interest rates may tend to reverse this trend. Also, the criterion that in theory governs investment decisions—the "capitalization rate" to be applied to an expected future income stream—will have changed, with perhaps some impact on the demand for land and other capital goods. But such possible effects must be broached with great caution, as numerous studies indicate that the rate of interest is only one of many factors involved in these matters, and that it has not usually been among the more important variables.

EMANUEL MELICHAR
Board of Governors of the Federal Reserve System

Iowa State Center for Agricultural and Economic Development, *Food Goals, Future Structural Changes, and Agricultural Policy: A National Basebook,* Ames, Iowa State University Press, 1969. x + 325 pp. ($5.95)

"This monograph was planned and written," the preface says, "to provide better bases for evaluating and formulating long-run policies for U.S. agriculture. The problems of agriculture with us today are largely the same as those of three decades back, just as are the policies which we employ . . . we could spend [another $60 billion] over the next fifteen years and still have the problem with us . . . should we look to other policy means and broaden the definition of the farm problem?"

The committee that organized the book arranged for 14 papers to be prepared on such topics as the world food situation, structural changes in agriculture, farm price and income programs, political forces in agriculture, goals, equity problems, noncommercial farmers, rural communities, and export policies. The 20 authors and co-authors, most from Land-Grant universities, are well-known in the field of agricultural policy. The problems most emphasized are (1) the threat to commercial farm income represented by excess capacity, (2) the virtual necessity of further drastic reduction in farm numbers and population, with attendant human problems, (3) declining economic opportunity facing many nonfarm rural people, (4) the difficulty of providing adequate services in rural communities, (5) a high incidence of poverty in many rural areas, and (6) the need of poor countries for food assistance.

Policies favored in the book are not new as proposals, but putting them fully into effect would greatly change the emphasis of agricultural and rural policy. Support for education in rural areas would be much enlarged. Labor mobility would be increased by training in nonfarm skills, improved employment information, and relocation subsidies. Farmers on inadequate units would be eligible for early social security payments. Welfare payments and services to indigent unemployables would be stepped up. Efforts for rural development would be organized around the functional unit concept, more aid in community planning would be provided, and loans and grants would be selectively available for installation of service facilities. Abroad, the United States would provide food aid as support for self-help by poor countries and would pursue liberal trade policies to expand markets for farm products.

What policy for commercial farming would be if the authors had their way is, not surprisingly, somewhat ambiguous. Kaldor, Ogg, and Saupe, taking long-run improvement of the economic performance of agriculture as their objective, hope that resource adjustments eventually will permit price and storage programs to be operated mainly for stabilization purposes rather than for income support. Hathaway concludes that the total program in effect in the late 1960's is workable, politically tolerable, and will not suffer a quick demise. Castle and Butcher say that output control is necessary but that land withdrawal is an unsatisfactory way to do it. Tweeten thinks that dissatisfaction with farm programs "will lead to an effective organization of farmers themselves to regulate production and marketing in perhaps 20 years."

Though the book repeatedly describes the changing number and size of farms under the impact of new technology, it does not convey much impression of the ways in which farming is being knit more closely into the industrial economy. Almost nothing is said about vertical integration or competition from synthetics. Corporate ownership is too little discussed. The prospect that hired farm labor will be employed on industry-like terms, mentioned briefly from a welfare standpoint, is not discussed at all for its impact on the structure and behavior of commercial agriculture.

The book represents orthodox thought among agricultural economists on the topics it covers, which is presumably what a "basebook" should do. Most of the articles will make good reading references in policy courses; an article by Maddox on noncommodity programs should be especially useful. But it must be said that the book is largely a re-do of things that have been done several times before, is likely to have little impact on professional thought, and is not written in a style attractive to the general public.

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Mathew, E. T., *Agricultural Taxation and Economic Development in India*, London, Asia Publishing House, 1968, 204 pp. ($7.50)

This short book originated as a doctoral dissertation at Vanderbilt University in 1964. While it suffers from some of the defects of most dissertations—such as unnecessary citation of not always relevant authorities—on the whole it is one of the better examples of this genre. Dr. Mathew has not only read most of the scanty decent literature on agricultural taxation in India (or anywhere); he has also thought about it critically, and, what is more important and unusual, he has attempted to appraise empirically its relevance to India today. His book can therefore be recommended as a useful concise introduction to a complex subject.

The principal empirical work attempted in the book concerns the relative "burden" imposed by the present Indian tax system on the agricultural and nonagricultural sectors. Unsurprisingly, the principal result of this laborious exercise is that the burden of taxation is heavier on the nonagricultural than on the agricultural sector. In particular, the higher-income groups within the agricultural sector are, Dr. Mathew concludes, "undertaxed" relative both to those of comparable income levels outside agriculture and to low-income agriculturists. While the author might well have exercised even more skepticism than he did in his use of data from the National Sample Survey and other Indian sources, there seems no reason to doubt that his calculations, given available information, are useful and generally sound. What is much more questionable is this whole approach to the admittedly important question of the "incidence" of taxation. "Tax-burden" tables of the sort painstakingly constructed by Dr. Mathew, even apart from the inevitably disputatious nature of the assumptions needed to construct them, cannot really give us any useful information about the distribution of the tax burden because of the falsity of the basic underlying assumption that the existing distribution of income (before tax) would be the same if the tax system did not exist. This is not to deny that comparison of two such tables might not yield useful information on the distributional effects of potential tax changes, a purpose for which Dr. Mathew's work (like other recent burden studies) should prove useful, but it does mean that such statements as "per capita net burden . . . forms 3.22 percent of the per capita income of an agriculturist in India" (p. 49) have no real meaning.

Dr. Mathew's own recommendations for the reform of agricultural taxation in India are closely related to those of such earlier writers as Hicks, Kaldor, and Wald. In essence, he would convert the present land revenue system (which is he notes, for the most part little more than a crude acreage tax) into a tax based on "the potential income from each holding under average conditions of production . . . estimated on the basis of a soil classification according to productive capacity" (p. 145). This tax should he argues, "take on as many features of the income tax as possible" (p. 1[illegible])—aggregation of all household holdings, personal exemptions, progressive rates, exemptions of particular forms of saving, etc., are therefore all recommended. Certainly no one can criticize Dr. Mathew's proposals as "too simple," "too crude," or "too arbitrary," to use some of the phrases by which he characterizes earlier reform proposals by the Taxation Enquiry Commission, Groves and Jadhaven, and others. Indeed, a major problem with the recommended system is almost surely that it is not simple and arbitrary enough. Like most authors, Dr. Mathew appears to underrate greatly the cost and difficulty of assessing potential output in India (or anywhere) in relation to the benefits to be gained in terms of increased tax revenues or agricultural productivity. The ease of evasion is also underestimated. After all, a principal reason for the present inadequacy of the Indian land tax system is the debility of the administration, so it is surely incumbent on those proposing new and more complicated systems to undertake a serious examination of the land tax administration and its potential for improvement, for an ideal tax badly administered may well be of less than a simple, crude, and arbitrary tax badly administered, if that is the choice.

The other principal reason for the relatively light taxation of agriculture in India is of course political. Like most economists, the author does not discuss this crucial factor sufficiently to justify much confidence in the future of his proposals. Incidentally, it is most curious that he rejects (p. 107) the policy of keeping agricultural prices low relative to nonagricultural prices as an alternative way of "taxing" the agricultural sector precisely on administrative and political grounds, when, as suggested above, it is these very factors, which he does not even discuss, that make his own proposed tax solution appear dubious.

Finally, one technical point might be mentioned: Dr. Mathew proposes that special assessments (irrigation and betterment duties) be dropped if his proposed system is adopted because their function will then be adequately served by the combination of land tax assessment based on potential yield and proposed capital gains tax on sales of land (p. 147). This is not the place to pursue the argument, but this recommendation reveals some confusion on the appropriate relative roles of the capital gains tax, the land tax, and special assessments, and there is in fact still an important potential role for the latter even in a Mathew-type ideal tax system.

RICHARD M. BIRD
University of Toronto

Sewell, W. R., and Blair T. Bower, eds., *Forecasting the Demands for Water*, Ottawa, Canada, Department of Energy, Mines and Resources, 1968, xiv + 262 pp. ($1.50 paper)

The main body of this work consists of five papers dealing in turn with the forecasting of municipal, industrial, agricultural, recreational, and in-stream water demands. These papers were originally presented in a seminar held in Vancouver, B.C., in December, 1967. In addition, the volume contains an introductory chapter, a second chapter that develops a conceptual framework for water resources planning, and a final chapter that considers the sectoral papers in a Canadian setting.

In the introduction, the editors take the position that the widely used "requirements" approach, in which no input substitutions involving water are allowed, is unacceptable as a procedure for predicting water needs. Their position is summarized as follows: "The requirements approach rarely considers the effects of price and sacrificed alternatives, and rarely takes adequate account of the impacts of possible technological changes, improvements in water use efficiency, and public policy decisions relating to water utilization." As would be expected, this theme is central to most of the methodological discussions. However, the distinction between "requirements" and "demand" is not always clear. The two introductory chapters serve their purpose adequately, but there are several carelessly defined concepts in the introduction that the reader may find distracting; e.g., "At very low prices, individuals would take all they could possibly use, but as the price increases, the quantities demanded fall off rapidly. This relationship is referred to as the price elasticity of demand for water, in conventional economic jargon."

The five main papers develop their respective topics in a straightforward manner and, in so doing, review and summarize current literature. For the most part, these papers break little new ground but offer discussions of their respective topics that range in quality from good to excellent; and if the critiques are included as part of each paper, I consider them all exceptionally good. Although I am not familiar with two of the topics, I would judge Charles W. Howe's paper on "Municipal Water Demand," Blair T. Bower's paper on "Industrial Water Demand," and Allan C. R. Albery's paper on "In-Stream or Flow Water Demand" the best. My main objection to the paper on "Agricultural Water Demand" is that it does not even mention what I have come to consider the pioneering work in this area. The Beringer [1] and Moore [2] research of the early 1960's developed production functions for water based on the soil-moisture-plant system. These functions can be aggregated over farm units for regional relationships. The critique by Blair T. Bower considers the micro-macro aspect in a little more detail but still does not offer any significant insight. The "Water Based Recreation" paper by Peter H. Pearse should have been more explicit in discussing forecasting methods because this was the purpose of the seminar. However, the paper reads well; and if a reader is interested in specific methods, it is well referenced.

In my view, the value of this work is as a first reference for practicing resource economists who may be called upon to forecast water demands. In addition, I feel that a well designed intermediate or advanced resource economics course should include work in this area since a significant amount of water resources research is concerned with forecasting demand. Considering its price, quality, and range of topics, the present volume seems to have all of the necessary attributes of a supplemental text.

HOWARD C. HOGG
Economic Research Service, USDA

References

[1] BERINGER, CHRISTOPH, *An Economic Model for Determining the Production Function for Irrigation Water in Agriculture,* University of California, Giannini Foundation Res. Rep. 240, Feb. 1961.

[2] MOORE, CHARLES V., "A General Analytical Framework for Estimating the Production for Crops Using Irrigation Water," *J. Farm Econ.* 43(Pt. 1):876–888, Nov. 1961.

Talbot, Ross B., and Don F. Hadwiger, *The Policy Process in American Agriculture,* San Francisco, Chandler Publishing Co., 1968, xii + 378 pp. ($8.50)

"Our primary objective in writing this book," declared the authors, "was to try to develop a broad conceptual framework whereby students in courses in American government and politics, as well as those in introductory courses in agricultural economics and policy courses, could see why and how one important area of public policy has developed and changed over decades of time" [p. xi]. In carrying out their task, they have produced a well-organized, documented, readable analysis that offers fruitful insights into some of America's hallowed political and governmental institutions. This book, coming at a time when our system of government is being confronted with a major challenge from within, should prove useful and interesting, not only to students, but also to those who serve as actors or audience in the drama of American politics and government.

The central thesis of the book is, in the words of the authors, "that disagreements over farm policy flow from the sharp ideological and materialistic conflicts within American agriculture, and will continue to do so for the next few decades" (p. 1). Identifying the quest for power as the major variable in the political behavior of farmers, the authors trace the political and policy landmarks in American agriculture from the seedtime of the Republic to midpassage of the twentieth century.

Professors Talbot and Hadwiger have identified two philosophical strains in the mind of the American farmer: (1) Jeffersonian agricultural fundamentalism, with its ideological commitment to liberty, freedom, equality, grass roots democracy, and the family farm; and (2) the Hamiltonian ideology of aristocracy, elitism, earned wealth, private property, and the commercial farm. The pendulum of politics is, in part, a continuing ebb and flow within the parameters of this ideological dichotomy, and it is reflected in a "game of political musical chairs" in which the modern Jeffersonians and the modern Hamiltonians take turns in commanding the policy machinery of the U.S. Department of Agriculture (p. 37).

The cloak of ideology, however, hangs loosely on the American farmer. The authors see him also as a pragmatist in which his interests—diverse and sometimes contradictory—lead him often to play the role of Madisonian realist in promoting and supporting public policies that he believes will maximize his material interests and political power, sometimes irrespective of his ideological commitments. "He searches for both truth and power," the authors have written, and his "theology has to be molded to fit into his sense of capitalism; his mind has to reconcile the conflicts, if any, between his heart and his pocketbook" (p. 64).

Utilizing such slippery concepts as power, legitimacy, leadership, grass roots democracy, public interest, and national purpose, the authors have traced, in depth and with insight, the farmer's quest for power. The trail leads through the political parties and the voting booth, the farm organizations and their lobbies, the Presidency and the executive establishment, the labyrinthian bureaucracy of the U.S. Department of Agriculture, the Congress and its committee system, the Supreme Court, the institutions of the federal-state system, and some of the relevant agencies of American foreign policy. The trail also leads through an analysis of the whole range of agricultural policy issues and subissues that have preoccupied the attention of the farmer and his representatives during the present century.

The title of this book is accurate, in part. The book does examine, primarily from a historical point of view, many of the institutions, personalities, and other input factors in the system, and it does examine the major policy products. However, at this stage in our progress as social scientists, we have come to expect that a study of the policy process in American agriculture might be more deeply concerned than is this book with the process itself. Models of decision-making, theories of individual and collective choice, the nature and limitations of rationality and rational action, the role of information, relevant and meaningful criteria for policy evaluation—these are some of the vital topics that one might expect to receive considerable attention in a book dedicated to the development of a broad conceptual framework for the understanding of the process through which agricultural policy is formulated. For those readers who subscribe to a more "behavioral" persuasion, this book will probably be viewed not as a study of the policy process but rather as an analysis of institutional anatomy.

This modest sense of disappointment having been expressed, it should promptly be emphasized that there is much in this very useful and interesting volume that goes beyond mere institutional description and anecdotal recital. For instance, in their "whirlpool-counterwhirlpool" concept of bureaucratic power, the authors introduce a notion that seems to carry us a step closer to meaningful empirical testing of the concept of institutional equilibrium. Similarly, they make a contribution to the development of a "policy science" with their concept of "subissues"—that is, "the struggle for both change and the status quo that goes on within the main issue . . ." (p. 206). Furthermore, the authors should be congratulated for refusing to be trapped into evaluating agricultural policy and process in terms of that old familiar test, "the public interest." Their idea of a contest between a "policy creed" and a "democratic creed" struggling to determine the policy content of something called "the national purpose" offers a fruitful alternative to that befuddled notion, "the public interest."

In a provocative final chapter, Professors Talbot and Hadwiger appropriately examine such highly relevant issues as hunger and food production, poverty, the need for a rural renaissance, the coming shortage of land, the quantity and quality of rural education, and the question of how the national purpose can be served as long as the policy-making institutions in agriculture, especially the USDA, remain pawns in the game of political pluralism. Carefully avoiding definitive answers, the authors effectively convey the sense of complexity that permeates the making of policy in agriculture, and they place appropriate emphasis on the interplay between the forces of change and the forces of continuity in the American system.

SIDNEY BALDWIN
California State College at Fullerton

Books for listing in this section should be sent to the Book Review Editor (see inside front cover for address).

Books Received

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Announcements

WINTER MEETING
AMERICAN AGRICULTURAL ECONOMICS ASSOCIATION
WITH
ALLIED SOCIAL SCIENCE ASSOCIATIONS

December 28-30, 1969, New York City

SUNDAY, DECEMBER 28

9:00 a.m. **Macro-Simulation Models (Joint Session ES and AAEA)**
Chairman: George G. Judge, University of Illinois
Macro-Simulation Models—Specification and Evaluation of the Alternatives: Thomas H. Naylor, Duke University
Simulation Models as a Planning and Decision Tool for Developing Countries: A. N. Halter, Oregon State University, and Thomas J. Manetsch, Michigan State University
Discussants:
Richard Day, University of Wisconsin
E. P. Holland, World Bank
Glenn L. Johnson, Michigan State University
David Kresge, Harvard University

MONDAY, DECEMBER 29

10:30 a.m. **Current Economic Policies—Their Appropriateness and Effectiveness (Joint Session AEA and AAEA)**
Chairman: Dale E. Hathaway, Michigan State University
A Panel Discussion with Audience Participation
Panel:
Walter H. Heller, University of Minnesota
D. Gale Johnson, University of Chicago
John A. Schnittker, Kansas State University
Henry C. Wallich, Yale University

1:00 p.m. **Luncheon—AAEA**
Speaker:
John A. Hannah, Director, Agency for International Development

TUESDAY, DECEMBER 30

9:30 a.m. **Meeting the Changing Need for Agricultural Statistics**
Chairman: Joseph Ackerman, Farm Foundation
Social Change and Public Policy in Rural America: Data and Research Needs for the 1970s: J. Patrick Madden, Pennsylvania State University
Discussant:
Nathan M. Koffsky, Washington, D.C.
Changing Structure of Agriculture and Resulting Statistical Needs: Wesley B. Sundquist, ERS, USDA
Discussant:
Harold O. Carter, Council of Economic Advisors, Washington, D.C.

NOMINATING COMMITTEE, 1970-71 AAEA OFFICERS

In accordance with Article VII of the constitution, with the concurrence of the Executive Board, I have appointed the following persons as members of a committee to nominate persons to fill vacancies in offices of the Association for the year beginning August 1970.

Any member of the Association is eligible, and is invited to submit suggestions as to nominees to Dr. Breimyer as chairman, or to other members of the committee. Dr. Breimyer's address is Department of Agricultural Economics, 200 Mumford Hall, University of Missouri, Columbia, Missouri 65201.

Harold F. Breimyer, ex officio, *chairman*
Harold G. Halcrow
W. Keith Bryant
Joseph Willett
Charles R. Pugh

Dale E. Hathaway
President

AAEA DISTINGUISHED EXTENSION PROGRAM AWARD

To encourage the development of excellence in Extension economics work, the American Agricultural Economics Association will offer two awards of $250 in 1970. The award will be known as the Distinguished Extension Program Award. (The number of awards will be limited to one, unless the number of entries exceed ten.) Nominations for the award may be made by any member of the American Agricultural Economic Association and selection will be made from among those nominated. An individual may be nominated or two or more individuals may be nominated jointly. The purpose of the award is to recognize an outstanding program achievement, not to recognize an individual or individuals for noteworthy service as Extension economists over an extended period of time.

Each nomination must be made by separate letter to the Extension Award Selection Committee by March 1, 1970, accompanied by four copies of documentary evidence of the achievement of the person or persons nominated. Documentary evidence should include an adequate presentation of the following points, in this order: (1) names(s) and titles(s) of the person or persons nominated; (2) the problem about which the person or persons nominated built their Extension program and the objective(s) of the program; (3) clientele served; (4) the program developed to attain the objective(s), including analytical tools and techniques, and education methods and procedures used; and (5) program accomplishments in terms of clientele response and/or establishment of the validity of an Extension technique. If two or more persons are nominated jointly, the specific contribution of each to the Extension program. must be documented.

In order to be eligible for nomination, an individual or individuals must have had primary responsibility for the Extension program that supports the nomination. The program must have been active within one year of the date of nomination, and its subject matter content must be principally in the field of economics.

Each nomination will be evaluated on the quality of the program that supports the nomination, using the documentary evidence submitted with the nomination as the sole basis for making this evaluation. Equal weight will be given each of the following five characteristics of the program:

1. Its effectiveness as a catalyst to other Extension economists in embarking on new programs or in applying new concepts to existing programs.
2. Its contribution to greater proficiency of Extension personnel in economics programs.
3. Its effectiveness in bringing about a significant change in behavior and/or understanding of the clientele.
4. Originality in recognizing educational opportunities which lend themselves to solution by an Extension economics program.
5. Originality in the application of economic principles and tools of analysis to problem-solving situations in Extension.

Material should be sent to subcommittee chairman, Stephen J. Brannen, Department of Agricultural Economics, University of Georgia, Athens, Georgia 30601.

AAEA DISTINGUISHED UNDERGRADUATE TEACHER AWARD

To recognize and encourage meritorious performance in undergraduate teaching in agricultural economics, an award of $250 is provided for presentation by the American Agricultural Economics Association upon recommendation of the selection committee. Nominations for this award may be made by an individuals, a group of colleagues, or a department of agricultural economics by the submission of supporting materials according to the rules for this program. Renomination is invited if the materials are brought up to date and resubmitted.

Eligibility for Nomination

The nominee must

1. be actively engaged in teaching during the school year in which the nomination is filed with the selection committee, and have been actively engaged in teaching for not less than five years;
2. have demonstrated outstanding ability as an undergraduate teacher of agricultural economics subject matter.

Basis of Selection

The award will be made on the basis of

1. the nominee's ability to motivate and stimulate students;

2. the impression he has made upon his students by the mastery of his subject, his technique, his vision, and his attitudes;

3. evidence of his interest in the improvement of teaching through publication and participation in professional meetings directed toward improved teaching;

4. contribution to undergraduate education outside of the classroom through counseling, student placement, advice to the department student club, and similar activities;

5. service to the undergraduate program of the educational institution through extracurricular activities other than those included above, such as membership on college committees, teaching improvement efforts, and faculty leadship roles.

Materials to be Supplied by the Nominator

1. Six copies of a biography of the nominee, not to exceed 1000 words.

2. Six copies each of letter in support of the nominee from not more than five former students.

3. Letters from at least one representative of the nominee's institution regarding the nominee's activities in the area defined in points 3, 4, and 5 under "Basis for Selection."

4. Six copies of a list of materials developed and/or published by the nominee related to undergraduate instruction. The list may cite the development of items useful in teaching, such as course outlines, curricula, books, research reports, visual aids, charts, models, or other contributions.

Nominations

1. It is desirable to make nominations without the knowledge of the nominee, when this does not interfere with submitting a complete file of supporting letters, materials, and a biography. A nomination with supporting materials may be submitted by another individual, a group of colleagues, or a department. Anyone submitting a nominee from another institution will be referred to the department head of that institution for a coordination of efforts, if found to be agreeable to the two parties involved.

2. Six copies of all supporting materials are to be in the hands of the chairman of the selection committee by March 1, 1970.

3. The selection committee for the Teacher Award consists of six persons, either present or former undergraduate teachers, appointed for staggered terms, and will not include anyone nominated for the award. All members of the selection committee participate in the judging. The selection committee is empowered to recommend that no award be made if, in their judgment, none of the nominees is worthy of the award.

4. *Nominations with supporting materials for the Teacher Award should be sent by March 1, 1970, directly to the chairman of this subcommittee,* Carroll V. Hess, Dean, College of Agriculture, Kansas State University, Manhattan, Kansas 66502.

AAEA AWARDS FOR RESEARCH IN AGRICULTURAL ECONOMICS

To recognize and encourage meritorious research in agricultural economics, 10 awards will be offered in 1970 by the American Agricultural Economics Association. Seven awards will be $250 each, and three, $100 each.

Selection for the awards will be made from published research, doctoral theses, master's theses, and articles in the *American Journal of Agricultural Economics* under the procedures outlined below. No one may receive more than one award in any one year, nor an award in the same category more than once every three years. No publication shall be eligible for an award if its substantive equivalent has received an award in any category in an earlier year. All materials submitted should be in English or accompanied by an English translation.

Awards for Published Research

1. Three $250 awards are offered for outstanding research publications in agricultural economics. These may include bulletins, articles, pamphlets, and monographs, but not textbooks. Joint authors of a winning report will receive proportionate shares of an award, so far as eligible.

2. Submissions are invited from areas such as farm management, marketing, prices, cooperation, finance, policy, theory, methodology, rural development, farm population, foreign agriculture, land and water economics, conservation, regional adjustment, international trade, economic history, state and local government, that throw significant light on the agricultural economy. Entries will be judged as a group rather than in particular areas.

3. Selections will be made from published research bearing a publication date in 1969.

4. Eligible recipients must be under 41 years of age at the time of publication, but may have older joint authors.

5. Any paper authored or co-authored by a member of this awards committee will be ineligible.

6. No penalty for joint authorship will be imposed unless one or more authors are over 41 years of age.

7. Each published report may receive only one award presented by the American Agricultural Economics Association in 1970. However, a report may be entered in more than one of the following categories: (a) Best article in the Journal of Agricultural Economics; (b) Published research; (c) Doctoral thesis; and (d) Master's thesis.

8. Thirteen copies of each publication should be submitted for consideration, unless expense to the individual is excessive.

9. The Awards subcommitte for published research consists of 12 persons in addition to the chairman, representing various fields. The members of the subcommittee will serve as voting judges, except the chairman, who will vote only in the event of a tie. The chairman of this subcommittee is G. Edward Schuh, Department of Agricultural Economics, Purdue University, West Lafayette, Indiana 47901.

10. *Publications should be sent directly to the chairman of this subcommittee before February 15, 1970.*

Awards for Doctoral Theses

1. Three $250 awards will be available for theses prepared by candidates for the doctoral degree in any department engaged in training agricultural economists at the doctoral level.

2. An entry must be submitted by the head of the department where the thesis was presented in partial fulfillment of requirements for a degree. A department may submit one thesis for each twelve doctoral theses or fraction thereof presented, in agricultural economics, to a graduate school faculty in the year. In determining the number of eligible theses, departments should limit consideration to theses of candidates who will receive a degree in agricultural economics and to theses of candidates who have taken agricultural economics as a field of emphasis.

3. Selection will be made from theses approved in final form by the student's advisory committee during the calendar year 1969, provided the candidate has met all other formal requirements for the doctoral degree.

4. A published thesis may be entered in both the published research and thesis classes but will be eligible for only one award. Although a published thesis is acceptable, a copy of the thesis as submitted to the graduate faculty should be sent whenever possible.

5. Three copies of a thesis must be sent to the subcommittee chairman. All copies will be returned after they have been read by the judges.

6. The awards subcommittee for doctoral theses will consist of twelve persons in addition to the chairman. All members of the subcommittee will serve as voting judges except the chairman, who will vote only in the event of a tie. The chairman of this subcommittee is Willard F. Williams, Department of Agricultural Economics, Texas Technological College, P.O. Box 4169, Lubbock, Texas 79409.

7. *Theses should be sent directly to the chairman of this subcommittee before February 15, 1970.*

Awards for Master's Theses

1. Three $100 awards will be available for theses prepared by candidates for the master's degree in any department engaged in training agricultural economists at the master's degree level.

2. An entry must be submitted by the head of the department where the thesis was submitted in partial fulfillment of requirements for a degree. A department may submit one thesis for each fifteen master's theses or fraction thereof presented to a graduate school faculty in the year. In determining the number of eligible theses, departments should limit consideration to theses of candidates who will receive a degree in agricultural economics, and to theses of candidates who have taken agricultural economics as a field of emphasis. Departments are strongly encouraged to submit either ribbon copies, in the case of typewritten theses, or Xerox or other processed copies of comparable quality.

3. Selection will be made from theses approved in final form by the student's advisory committee during the calendar year 1969, provided the candidate has met all other formal requirements for the master's degree.

4. Three copies of a thesis must be sent to the subcommittee chairman. All copies will be returned after the committee has completed its work.

5. A published thesis may be entered in both the published research and thesis classes, but will be eligible for only one award. Although a published thesis is acceptable, a copy of the thesis as submitted to the graduate faculty should be sent whenever possible.

6. The awards subcommittee for master's theses will consist of six persons in addition to the chairman. All members of the subcommittee will serve as voting judges except the chairman, who will vote only in the event of a tie. The chairman of this subcommittee is Eldon E. Weeks, Farm Income Branch, editorial council of the Journal of Agricultural Economics, with the editor as D.C., 20250; Phone 202-388-2242.

7. *Theses should be sent directly to the chairman of this subcommittee before February 15, 1970.*

Award for Best Article in the *American Journal of Agricultural Economics*

As has been the practice for a number of years, the editorial staff and the editorial council of the *American Journal of Agricultural Economics,* with the editor as chairman, will choose the most outstanding article published in the Journal during the preceding calendar year (in this instance, 1969). The amount of this award is $250.

Announcements of the 1970 awards will be made at the 1970 annual meeting of the American Agricultural Economics Association. Names of the recipients of the 1969 awards appear in the 1969 proceedings issue of the *American Journal of Agricultural Economics.*

These awards are financed in part from funds donated by persons and firms interested in advancing research and scholarship in agricultural economics. The funds and programs are administered by the American Agricultural Economics Association. General inquiries and requests for additional copies of this announcement should be sent to the chairman of the Awards committee, Emery N. Castle, Department of Agricultural Economics, Oregon State University, Corvallis, Oregon 97331.

WESTERN AGRICULTURAL ECONOMICS ASSOCIATION

The 1970 meeting of the Association will be held at Tucson, Arizona, July 19–22.

The Association has published a monograph entitled *The Western Agricultural Economics Association: Aspirations and Achievements,* by D. B. DeLoach. Association members will receive a copy of the monograph and nonmembers may obtain copies at $1.00 from Leo R. Gray, Secretary-Treasurer, Western Agricultural Economics Association, P.O. Box 89, Berkeley, California 94701.

OFFICE OF WATER RESOURCES RESEARCH

The Office of Water Resources Research is now accepting unsolicited research proposals in the field of water resources pursuant to Title II of the Water Resources Research Act of 1964, as amended. Although proposals may be submitted to OWRR at any time, those received after October 1, 1969, will be held for future consideration, i.e., for fiscal year 1972 or thereafter.

Detailed instructions and forms for the submission of proposals for consideration for funding under the Title II provisions of the Water Resources Research act may be obtained from the Director, Office of Water Resources Research, U.S. Department of the Interior, Washington, D.C. 20240.

TEXAS A&M UNIVERSITY

The Texas Agricultural Market Research and Development Center, a new research center in agricultural economics, has been announced by Texas A&M University. The Center has a program of marketing strategy research and education designed to assist agricultural groups and agribusiness firms in evaluating and solving their immediate and emerging marketing problems. The Center is a part of the Department of Agricultural Economics and Sociology.

Robert Branson, professor of agricultural economics, is directing this new research program. Other members of the department associated with the Center are William Black, extension marketing specialist; Chan Connolly and Randall Stelly, associate professors; John Nichols and Thomas Sporleder, assistant professors. Food technologists, statisticians, psychologists, sociologists, and other specialists are included in research task forces according to the nature of each marketing problem.

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

The *Journal of the American Statistical Association* is to be divided into two sections, "Theory and Methods" and "Applications," a change designed to stimulate the submission of more quality manuscripts applying statistical methods to substantive problems. Particularly desired are good manuscripts in social science. Robert Ferber, Applications Editor, states that "a major attraction of *JASA* to prospective authors about which you might care to know is its policy of publishing manuscripts, after acceptance, in the very next issue to go to press. Hence, *JASA* has no backlog." Manuscripts in the applications area should be addressed to Robert Ferber, Applications Editor, Survey Research Laboratory, University of Illinois, Urbana, Illinois 61801.

WESTERN AGRICULTURAL ECONOMICS RESEARCH COUNCIL

In August 1968 WAERC restructured its committee system into three groups, plus a provision for ad hoc committees to consider the emerging problems and issues as deemed necessary. The three new committees are: (1) Committee on Commercial Agriculture; (2) Committee on Natural Resources Development; and (3) Committee on Community and Human Resources Development. Functions of the new committees will be:

(a) To aid in defining important research needs and in developing means for meeting them.
(b) To stimulate and develop professional exchange among research personnel in our region.
(c) To develop specific research project proposals.

Lynn G. Sleight, MED at University of Illinois; **Thomas T. Stout**, on leave from Ohio State University, MED; **Abner W. Womack**, Long-Run Projections Section, Outlook and Projections Branch, ESAD; **Henry L. Wong**, Ph.D. Hawaii, 1969, MED.

Transfers: **John H. Droge**, MED from Madison to Washington, D.C.; **Opie C. Hester**, C&MS at Rosslyn, Virginia, from Poultry Section, Commodity Analysis Branch, ESAD; **John M. Himmelberg**, from Farm Income Estimates Section, Farm Income Branch, to Demand Analysis Section, Outlook and Projections Branch, ESAD; **J. Blake Imel**, MED, from Berkeley to Madison; **David A. Lins**, FPED, from Washington, D.C. to Urbana; **William C. Motes**, Director, EDD, from FEPS; **John B. Penson, Jr.**, FPED, from Washington, D.C. to Urbana; **Jerry A. Sharples**, FPED, from Washington, D.C. to Lafayette, Indiana.

Leaves: **Cecil W. Davison**, returned to FPED after three years in army; **Robert D. Reinsel**, returned to FPED after two years of graduate study, under Employees Training Act, at Michigan State University.

Resignation: **Arthur G. Conover**, as agricultural economist in office of the director, ESAD.

Awards: **Wesley B. Sundquist**, Director, FPED, and **James Vermeer**, FPED, USDA Superior Service awards.

UNIVERSITY OF FLORIDA

Appointments: **Wallace Kenneth Boutwell**, as assistant dean of faculties for resources planning; **James R. Conner**, Ph.D. Texas A&M, 1969, and **Kamal Dow**, Ph.D. Missouri, 1969, assistant professors.

UNIVERSITY OF IDAHO

Appointments: **Karl H. Lindeborg**, returned from sabbatical at University of Oslo, professor; **Edgar L. Michalson**, formerly with FPED, ERS, USDA, at Washington State University, associate agricultural economist, Water Resources Institute; **Robert L. Sargent**, formerly visiting associate professor, extension marketing specialist.

IOWA STATE UNIVERSITY

Appointment: **Charles P. Gratto**, associate professor.

Leave: **Lehman B. Fletcher**, faculty improvement leave (six months).

UNIVERSITY OF MASSACHUSETTS

Appointment: **Robert Vertrees**, Ph.D. candidate, Michigan State, teaching-research assignment in resource economics.

Retirement: **Ellsworth W. Bell**, after 40 years of service.

MICHIGAN STATE UNIVERSITY

Appointments: **L. L. Boger**, Dean, College of Agriculture and Natural Resources; **Dale E. Hathaway**, chairman of department.

Leaves: **John Ferris**, in England directing a study of agriculture of EFTA countries; **Donald Larson**, USAID, Colombia (one year); **Lawrence W. Witt**, Ford Foundation, Lahore, Pakistan (three months).

UNIVERSITY OF MINNESOTA

APPOINTMENTS: **Emiel W. Owens**, Prairie View A&M College, Texas, visiting professor in human resources (one year); **Herbert H. Stoevener**, Oregon State University, visiting professor in resource (recreation) economics (one year).

LEAVES: **Martin E. Abel**, Ford Foundation program advisor in agricultural economics, India (two years); **Reynold P. Dahl**, party chief, Minnesota-AID Tunisia project, Tunisia (one year); **John D. Hyslop**, returned from two-year assignment on Minnesota-Tunisia project; **Vernon W. Ruttan**, fall quarter, 1969.

AWARD: **E. Fred Koller**, Alumni Achievement Award, Augustana College, Sioux Falls, South Dakota.

UNIVERSITY OF MISSOURI

APPOINTMENTS: **Charles L. Cramer**, assistant chairman of the department; **Jack D. Timmons**, formerly of the University of Nebraska, instructor.

LEAVES: **J. Wendell McKinsey**, returned from five years of service as chief of party, India program; **Philip F. Warnken**, Ford Foundation, Sao-Paulo, Brazil.

NEW MEXICO STATE UNIVERSITY

APPOINTMENTS: **Shaul Ben-David**, formerly visiting assistant professor, Cornell University, associate professor of natural resources; **William D. Gorman**, formerly of Purdue University and Stanford Research Institute, associate professor, agricultural marketing and prices; **Garrey Edward Carruthers**, Ph.D. Iowa State, 1969, assistant professor in regional economics.

PURDUE UNIVERSITY

APPOINTMENTS: **L. M. Eisgruber**, assistant department head for research (three-year term); **H. A. Wadsworth**, assistant department head for extension (three-year term, beginning Feb. 1, 1970, after six-month leave at Oregon State University); **Larry P. Bohl**, Ph.D. Purdue, 1969, assistant professor.

LEAVES: **Julian H. Atkinson**, chief of party, Purdue-Brazil project, Brazil (two years); **Edward E. Carson**, University of California, Berkeley (six months); **Bob F. Jones** and **George F. Patrick**, returned from two years with Purdue-Brazil project, Brazil; **Don Paarlberg**, director of agricultural economics, USDA (one year); **T. Kelley White**, Purdue-Brazil project, Brazil (two years).

RETIREMENTS: **John B. Kohlmeyer**, after 44 years of service in Cooperative Extension Service and School Reorganization; **Harry W. Leonard**, after 32 years in agricultural education and economics.

AWARDS: **J. Carrol Bottum**, Hillebrand Distinguished Professor, Purdue University, and honorary Doctor of Science degree, South Dakota State University; **Emerson M. Babb**, Social Science Research Council Senior Research Fellowship for study in behavioral sciences, University of California, Berkeley (one year); **J. W. Judy, Jr.**, Outstanding Teacher award of Student Government; **Don Paarlberg**, Outstanding Teacher award of the university.

SOUTHERN ILLINOIS UNIVERSITY

Appointments: **Gordon Langford**, Ph.D. Montana State, 1969, assistant professor.

Leave: **Walter J. Wills**, Fulbright lecturer, Ege University, Barnova, Turkey (1969-70).

TEXAS A&M UNIVERSITY

Appointments: **William C. Brown**, on leave from Oregon State University, Texas A&M Contract team, Argentina, to train South American students in agricultural economics; **Robert E. Whitson**, M.S. Texas Technological College, 1969, extension area farm management specialist, Gonzales, Texas.

Leave: **Vance W. Edmondson**, returned from five-year assignment with National Institute of Agricultural Technology, Argentina.

Retirement: **Aden C. Magee**, as professor of farm management, after 42 years of service.

WASHINGTON STATE UNIVERSITY

Appointments: **Dennis Oldenstadt**, assistant director of Agricultural Research Center; **Kenneth Casavant**, Ph.D. candidate, Washington State, instructor.

Leaves: **Laszlo Valko**, international cooperative conferences and study of agricultural cooperative and credit systems in Germany, Switzerland, and Austria (three months); **Eldon E. Weeks**, ERS, USDA, Washington, D.C. (one year).

WEST VIRGINIA UNIVERSITY

Appointments: **Kenneth D. McIntosh**, acting director of newly created Division of Resource Management (including agricultural economics, agricultural engineering (research), and landscape architecture); **James H. Clarke**, acting chairman, Committee of Agricultural Economics, Division of Resource Management.

UNIVERSITY OF WISCONSIN

Appointments: **Charles W. Loomer**, Secretary of the Faculty, Madison; **Willard Mueller** of the Federal Trade Commission, Vilas Professor of Agricultural Economics; **William Dobson**, Ph.D. Purdue, 1969, and **Emil Haney**, Ph.D. Wisconsin, 1969, assistant professors.

OTHER APPOINTMENTS

Victor F. Amann, formerly of West Virginia University, senior lecturer, Makerere University, Kampala, Uganda.

Juan A. Aquirre, Ph.D. Cornell, 1969, academic staff, Inter American Institute of Agricultural Sciences, Turrialba, Costa Rica.

Donald Audt, Ph.D. Missouri, 1969, economist, Land-O-Lakes Creameries, Minneapolis.

George Brinkman, formerly of Michigan State University, assistant professor, Kansas State University.

Harold B. Brown, M.S. Purdue, 1969, Cooperative Extension Service, Ohio State University.

Joseph D. Coffey, formerly assistant professor, University of California, Berkeley, Planning Evaluation and Programming Staff, USDA, Washington, D.C.

Bruce W. Cone, Ph.D. Purdue, 1969, operational analysis and economics department, Battelle-Northwest.

Lee M. Day, department chairman, Pennsylvania State University, succeeding Macklin E. John, returned to teaching and research.

Ralph K. DeHaven, Ph.D. Missouri, 1969, assistant professor, Clemson University.

Danny C. Denton, M.S. Arkansas, 1969, instructor, University of Arkansas.

William D. Dobson, Ph.D. Purdue, 1969, assistant professor, University of Wisconsin.

Richard L. Duffy, M.S. Purdue, 1969, commodity analysis division, Pillsbury Mills, Minneapolis.

Roberto P. Echeverria, Ph.D. Cornell, 1969, economist, International Bank for Reconstruction and Development, Washington, D.C.

Mohammed Hassan Fag El Nour, Ph.D. Wisconsin, 1969, National Institute of Planning, Cairo.

Robert H. Elrod, Ph.D. Clemson, 1969, assistant professor, Georgia State College.

Robert E. Evenson, formerly of the University of Minnesota, Department of Economics and Economic Growth Center, Yale University.

Ernest Feder, formerly chief of agricultural section, ECLA/UN, Mexico, director of UN/FAO Institute of Land Reform, Ceylon.

Luis R. Flores, M.S. Purdue, 1969, Banco Nacional de Fomento, Enterprise Development Division, Tegircigalpa, D.C. Hounduras, C.A.

Richard J. Foote, professor in statistics and price analysis, Texas Technological College.

James R. Garrett, acting chairman, Division of Agricultural and Resource Economics, University of Nevada (Sept. 1969-June 1970), in absence of **John W. Malone, Jr.**, on leave as American Council on Education Fellow (Ford Foundation), Purdue University.

Wendell Gottman, M.S. Missouri, 1969, Tractor Operations, Ford Motor Company, Birmingham, Michigan.

Charles H. Greene, New Mexico State University, agricultural economist, American Sheep Producers Council, Denver (Jan. 1969).

Douglas D. Hedley, formerly of Michigan State University, agricultural economist, International Institute of Tropical Agriculture, Ibadan, Nigeria.

Robert W. Herdt, Ph.D. Minnesota, 1969, assistant professor, University of Illinois.

Aaron A. Hutcheson, Ph.D. Clemson, 1969, chairman, economics department, Austin Peay State University, Clarksville, Tennessee.

Ashmore Johnson, M.S. Purdue, 1969, government position, Kingston, Jamaica.

John W. Judy, Jr., formerly of Purdue University, head of veterinary medicine and surgery department, University of Georgia.

Amir Khalili, Ph.D. Missouri, 1969, assistant professor, School of Business Administration, Cleveland State University.

Carl B. Lewis, Ph.D. Nebraska, 1969, acting chairman of economics department, Kearney State College, Kearney, Nebraska.

Harold Love, Ph.D. Missouri, 1969, assistant extension professor, University of Kentucky.

Ben R. McManus, Ph.D. Purdue, 1969, assistant professor, University of Tennessee.

Euter Paniago, Ph.D. Purdue, 1969, returned to Purdue-Brazil project, Vicosa, Brazil.

Abdel-Hamid Y. Saad, Ph.D. Cornell, 1969, Ministry of Supply, United Arab Republic.

Lester Schmid, formerly of Land Tenure Center, University of Wisconsin, Southwest Minnesota State College.

Alvin Schupp, Ph.D. Missouri, 1969, assistant professor, Louisiana State University.

Ismail Sener, formerly of University of Nebraska, chairman of agricultural marketing department, Ministry of Agriculture, Turkey, and agricultural advisor of Turkish Permanent Delegation to EEC.

Mahfouz E. Tadros, Ph.D. Cornell, 1969, research associate in water resources, Cornell University (one year).

Jack Thornton, Ph.D. Missouri, 1969, associate professor, East Carolina State College, Greenville, North Carolina.

Benjamin Villanueva, formerly of Land Tenure Center of University of Wisconsin, economist in charge of price policy, SIECA, Guatemala.

Tae-Hee Yoon, formerly of Lakehead University, Ontario, senior economist, Planning and Evaluation Branch, Canada Department of Manpower and Immigration, Ottawa.

OTHER LEAVES

Loyd Fischer, University of Nebraska, one-year assignment in La Paz, Bolivia.

OTHER AWARDS

Vernon R. Eidman, Oklahoma State University (with **Harold O. Carter** and **Gerald W. Dean**, University of California, Davis), WAEA 1969 Certificate of Merit for outstanding published research (Giannini Foundation Monograph No. 21: *Decision Models for California Turkey Growers*, July 1968).

Hiroshi Mori, chief of international affairs section, Ministry of Agriculture and Forestry, Tokoyo, award at annual convention of Agricultural Economics Society of Japan for work in agricultural marketing done as visiting professor at Purdue University (with W. L. Gorman).

OBITUARY

Alois F. Wolf, 69, a former employee of USDA's Economic Research Service, died on June 24, 1969, in Edison, New Jersey, where he had been residing. Born in Germany in 1899, he received a B.S. degree in 1920 and an M.S. degree in 1924 from Teachers College in Breslau. He came to the

United States in the late 1920's and worked for USDA's AAA from 1934 to 1936. Then, until 1958, he was market Manager for the Dromedary Company, a division of the National Biscuit Company. For several years during this period, he served as a consultant to the Florida Citrus Mutual and the American Cranberry Exchange. Mr. Wolf returned to USDA in 1958 and worked as an agricultural economist until his retirement in 1966.

ADDITIONS TO LIST OF DOCTORAL DEGREES CONFERRED IN 1968

Harold Dean Bauman, B.S. Oklahoma A&M College, 1949; M.S. Oklahoma A&M College, 1950; Ph.D. Ohio State University, *Farm Mortgage Credit: An Analysis of Factors Influencing Its Supply and Demand.*

Grover Wayne Burkhart, B.S. Ohio State University, 1949; M.S. Ohio State University, 1957; Ph.D. Ohio State University, *Costs of Using Selected Sprinkler Irrigation Systems in the Upper Mad River Valley Area of Ohio.*

David Garvin Cartano, B.S. Iowa State University, 1957; M.S. Ohio State University, 1961; Ph.D. Ohio State University, *Social Integration and Conflict in a Developing Community of the Colombian Interior.*

Arthur William Chaffee, B.S. Ohio State University, 1951; M.S. Ohio State University, 1952; Ph.D. Ohio State University, *The Adoption of Modern Agricultural Facilities by Subsistence Farmers in Central Mexico.*

Chancy Calvin Connolly, Jr., B.S. Ohio State University, 1940; M.S. Ohio State University, 1965; Ph.D. Ohio State University, *Consumption and Saving Functions with Probability of Real Estate Debt Repayment, U. S. Agricultural Sector, 1961.*

Donald Allan Derr, B.S. Ohio State University, 1962; M.S. Ohio State University, 1964; Ph.D. Ohio State University, *An Economic Analysis of Alternative Information Systems for Real Property Records.*

Daniel Howard Doster, B.S. Ohio State University, 1955; M.S. Ohio State University, 1959; Ph.D. Ohio State University, *Feasibility of Producing Processing Vegetables on Irrigated Corn Belt Land.*

Gameh Moustafa Gameh, B.S. Cairo University, 1955; M.S. Ohio State University, 1965; Ph.D. Ohio State University, *Growth Potential of Muskingum County, Ohio: An Economic Base and Input-Output Study.*

Aaron Andrew Hutcheson, B.S.A. University of Florida, 1958; M.S.A. University of Florida, 1965; Ph.D. Clemson University, *Socio-Economic Characteristics of Consumers and the Demand for Fresh Peaches.*

Christopher Oladosu Ilori, B.S. McGill University, 1956; M.S. University of Toronto, 1958; Ph.D. Stanford University, *Economic Study of Production and Distribution of Staple Foodcrops in Western Nigeria.*

Frederick James Rafeld, B.S. Ohio State University, 1962; M.S. Ohio State University, 1965; Ph.D. Ohio State University, *An Analysis of the Influence of Personal Attitudes, Goals, Management Ability, and Growth Strategies in Farm Firm Growth.*

Bobby Hugh Robinson, B.S. Berea College, 1964; M.S. North Carolina State University, 1966; Ph.D. Clemson University, *An Economic Analysis of* *the Effects of Changing Technology and Government Cotton Programs on Farm Income and Organization, Upper Coastal Plain, South Carolina.*

Herbert Roth, B.S. Ohio State University, 1962; M.S. Ohio State University, 1964; Ph.D. Ohio State University, *Adaption of Benefit-Cost Analysis to the Measurement of Performance of Agricultural Development Banks.*

Donald Melvin Sorensen, B.S.A. University of Nebraska, 1958; M.S. Colorado State University, 1964; Ph.D. Ohio State University, *Capital Productivity and Management Performance in Small Farm Agriculture in Southern Brazil.*

Thomas Lynn Sporleder, B.S. Ohio State University, 1964; M.S. Ohio State University, 1965; Ph.D. Ohio State University, *An Econometric Investigation of Regional Interdependency in the Processing Tomato Industry.*

Smith Thomas Stickley, B.S. Ohio State University, 1956; M.S. Ohio State University, 1964; Ph.D. Ohio State University, *Factors Associated with Incomes of Ecuadorian Farmers.*

Donald Earl Zehr, B.S. Purdue University, 1936; M.S. Ohio State University, 1959; Ph.D. Ohio State University, *The Control of the Transportation of Milk from Farm to Market and Its Effect on the Bargaining Position of Dairy Marketing Cooperatives.*

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JOURNAL OF AGRICULTURAL ECONOMICS

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Secretary: Dr. T. W. Gardner, Department of Agricultural Economics, The University, Manchester, 13.

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New Editions of Classic Texts

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By the late Harry O. Buckman, formerly, Cornell University, and Nyle C. Brady, Cornell University

This classic text offers a complete introduction to the nature and properties of soils, especially as they relate to the growth of plants. The seventh edition is an updating of the entire book, reflecting the latest research findings in soils, and the following chapters have been completely revised: Soil Formation, Classification and Survey; Soil Colloids: Their Nature and Practical Significance; Soil Reactions: Soil Acidity and Alkalinity; and The Nitrogen Economy of Soils. A new section concerned with sulfur has been added. Numerous tables, diagrams, and photographs, including soil maps which employ the new comprehensive classification scheme, are presented.
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Revised to reflect current developments and research, this fine text includes material on new and developing breeds, with particular emphasis on the shifting population of various breeds of livestock. Organized on the basis of an historical presentation and evaluation of each breed, the book is designed to acquaint the student with the special attributes and limitations which determine the past importance and future potential of the breeds of livestock generally found in the United States. Charts, tables, and illustrations have been extensively updated.
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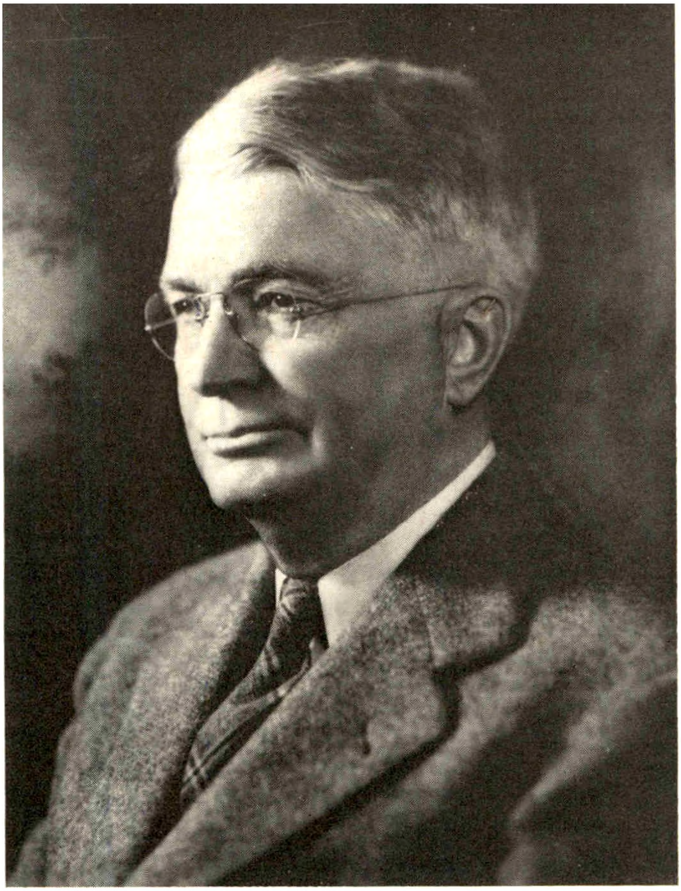

Henry Charles Taylor
1873–1969

HENRY CHARLES TAYLOR died April 28, 1969, at age 96 in Washington, D.C. His professional life spans the life of our profession. Our association honored him as one of the pioneers, first as its president in 1920 and more recently as one of the first to receive a fellowship [3].

H. C. Taylor was born and raised on an Iowa farm. He earned his B.S. and his M.S. degrees from Iowa State University. Before finishing his Ph.D. at Wisconsin in 1902, he studied at the London School of Economics, Halle-Wittenberg University, and the University of Berlin.

As a professor in the University of Wisconsin's Commerce Department, he taught a course in agricultural economics in 1903. He was listed as a professor of agricultural economics in the Wisconsin College of Agriculture in 1907; and when an agricultural economics department was formed in 1909, Professor Taylor became its first chairman [4, pp. 270–273].

Professor Taylor said, in the first B. H. Hibbard Memorial lecture, "Agricultural economics had its early growth as a part of general economics on the one hand, and as a part of agronomy on the other hand." He lists six pioneers: Warren, Spillman, and Boss, who entered the field from agronomy; Carver, Hibbard, and himself, who were all students of Richard T. Ely and brought general economic training to bear on the problems and policy issues of farmers [7].

Taylor's concept of agricultural economics was a broad and inclusive one. This was evident as early as 1910 when he persuaded Professor Galpin, a rural sociologist, to join the staff [4, pp. 270–273]. To Taylor, history and economic geography were also important in analyzing and resolving rural economic issues. He was an early user of the dot map to present information. Professor Taylor's Ph.D. thesis analyzed land ownership problems in England. The first Wisconsin Experiment Station bulletin on an agricultural economics subject, published in 1910, was *Methods of Renting Farm Lands in Wisconsin*, by H. C. Taylor [9].

Early in 1919, Professor Taylor became chief of the Office of Farm Management in the U.S. Department of Agriculture and, at the same time, was assigned to a commission whose purpose was to reorganize the Office [11, 13]. The commission's work resulted in the establishment of the Bureau of Agricultural Economics within USDA in July 1921, with Dr. Taylor its first chief [5, p. 152]. As chief of BAE, USDA, until 1925, Dr. Taylor had a large responsibility for, among other things, expanding the agricultural information services, inaugurating the Agricultural Outlook Service, establishing foreign outposts of USDA to get better information on world production and consumption, and putting the exports of American crops, particularly cotton, on American grading standards [8, p. 63; 1, p. 1100]. H. C. Taylor would want us to remember him as the one who organized and made function a large government bureau which did research and supplied information for better decisions on the broad program and policy issues of agriculture. In fact, his involvement in the controversial McNary-Haugen legislation might have had something to do with his retirement soon after the death of Secretary of Agriculture H. C. Wallace on October 25, 1924.

Before becoming the first managing director of the Farm Foundation in 1935, a post he held for ten years, Taylor was professor of agricultural economics at Northwestern University, directed a comprehensive study of rural Vermont, and was the U.S. member of the permanent committee of the International Institute of Agriculture, Rome, Italy.

During Taylor's administration, the Farm Foundation focused on the broad problems of rural communities and encouraged closer working relations between research specialists in the state colleges of agriculture and those in USDA [2, 10]. Under the sponsorship of the Farm Foundation Professor Taylor authored *The Story of Agricultural Economics*, published in 1952 [12, pp. 82–85].

A major contribution to our profession and one not often noted, is Taylor's effort to improve the working relationship of agricultural economists in the state colleges and in the U.S. Government agencies. The report of the Commission outlining the establishment of BAE contains an excellent statement on desirable research relationships between state and Federal specialists. While in charge of the Farm Foundation, he directed its main efforts toward encouraging coordination of the work of existing agencies and stimulating their staffs to initiate new lines of work.

Better documented and more widely known were Professor Taylor's continuous efforts to bring general economic theory and research methods to bear on the problems of agriculture. Recognizing the importance of making the individual farm efficient and profitable, Professor Taylor also included in agricultural economics those things important to agriculture that occurred beyond "the line fence"; hence, his interest in marketing, credit, prices, and ownership. He was a good teacher and his *Agricultural Economics* was the standard text for many years. He encouraged the American Economic Association in 1907 and 1908 to devote sessions to agricultural economics [6] . In 1910 at Ames, Iowa, a small group attending a graduate school seminar sponsored by the State Experimental Station Association formed the American Farm Management Association. Taylor disapproved of the name, and is credited with getting the Experiment Station Association to define farm management at its meeting in 1911 to include the general issues of the rural economy—marketing, credit, land tenure, rural living, and international trade. By 1919, definition of subject matter was not so important; and the American Farm Management Association, a marketing association, and a small fledgling association of agricultural economics merged to form our American Farm Economics Association. Whether the problems most affecting U.S. agriculture were credit and cooperatives in 1910-20, production control, adequate information, and international trade in 1920–30, or the problems of farmers losing their farms during the depression of the 30's, Henry C. Taylor was trying to apply research information toward improving the situation.

Taylor's interest in the profession continued until his death. Many of us knew him as an active member of our association and the International Association of Agricultural Economics. He also participated in the Washington chapter of the Taylor-Hibbard Club (members of this club bearing his name are students, staff, and alumni of the University of Wisconsin agricultural economics department, associated primarily to stimulate discussion of subject matter issues). At the time of his death he had prepared a manuscript on the economic history of the Iowa farm where he was born, which he felt illuminated the entire period of development of agriculture in the Midwest. It is in the process of publication.

R. J. Penn
University of Wisconsin

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NATHAN MORRIS KOFFSKY
Former Administrator of the Economic Research Service and Director of Agricultural Economics, U.S. Department of Agriculture
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Fellow, American Statistical Association

NATHAN M. KOFFSKY has made original and enduring contributions to general agricultural economics, national income estimation, agricultural-industrial relationships, and farm programs for underdeveloped countries.

His career in the U.S. Department of Agriculture extended from his temporary appointment to work on a BAE farm management survey in 1934 to his service as Administrator of the Economic Research Service, 1961–65, and as the Department's Director of Agricultural Economics in 1965–66. The high level of economic and statistical services achieved under his direction has enabled the Department to provide a broad perspective of American agriculture.

As a statistician, he pioneered the development of data showing the proportion of farmers receiving incomes of various sizes in relation to the value of their sales and was responsible for major advances in measuring the relative purchasing power of farm and nonfarm people. He also improved techniques for forecasting the effects of changes in aggregate domestic and foreign demand on farm prices and incomes and directed basic research in forecasting farmers' purchases from the industrial sector of the economy.

In the early sixties, he directed a comprehensive study of U. S. sugar policies for the House Committee on Agriculture and chaired a Department appraisal of the grain export policies of the Commodity Credit Corporation. He represented the United States at many international conferences, particularly those of the Food and Agriculture Organization and the Organization for Economic Cooperation and Development. He was especially influential in establishing a committee on the relation between agriculture and economic growth in the OECD countries, which completed an important study in 1965.

Nathan Koffsky's achievements were recognized by the USDA with a Superior Service Award in 1955 and a Distinguished Service Award in 1963. He served as vice-president of the American Farm Economics Association in 1959–60; was a member of the executive committee of the Conference on Research and Wealth of the National Bureau of Economic Research in 1953–55; and was elected a Fellow of the American Statistical Association in 1964.

As an economic program specialist with the Ford Foundation in India during 1966–67, he established an effective economic forecasting system for Indian agriculture. Subsequently, he has participated in several other research projects concerned with economic development in Asia and Latin America.

Nate was born in Albany, New York, in 1911. He received his B.A. from Cornell and his M.S. in economics from the American University in Washington, D.C.

JAMES GRAY MADDOX

Executive Director, Agricultural Policy Institute, North Carolina State University

Co-author, The Advancing South: Manpower Prospects and Problems, 1967

Formerly Bureau of Agricultural Economics, Farm Security Administration, American Universities Field Staff

JAMES G. MADDOX, through his perceptive writing and educational effort, has made major contributions in the fields of agricultural policy, economic growth of the southern region, and foreign development. He has devoted his life to bettering the economic conditions of rural people, particularly the rural poor. His interest has known no national boundary nor racial distinction.

James Maddox has always insisted that economics be applied to solving the problems society faces. His interest in agricultural policy goes back to his earliest years as an economist when he served as assistant to the chief of the Bureau of Agricultural Economics and as director of the Rural Rehabilitation Program of the Farm Security Administration in the 1930's. At North Carolina State University since 1958, Professor Maddox has been associated with the Agricultural Policy Institute in recent years and has served as its executive director since 1966. In this capacity he has organized conferences on a wide variety of topics related to the efficiency of the economy and the enhancement of incomes of rural people.

He served as research director for a four-year study, financed by the Twentieth Century Fund, concerned with development of the South. Out of this study a book, *The Advancing South: Manpower Prospects and Problems,* was published in 1967. In addition to this significant work, Dr. Maddox has written many papers and presented countless talks dealing with the problems of the South. Earlier in his career, Dr. Maddox was a Latin American specialist as a member of the American University's Field Staff from 1953 to 1958 and as an assistant director of the Rockefeller-financed American International Association from 1949 to 1952. In this period he produced a number of important papers and a book on Latin American institutions and problems.

His other contributions to the nation and to his academic and social community are immense. He has been a member of the Middle Atlantic Regional Manpower Commission and was a member of the Secretary of Agriculture's Public Advisory Committee on Rural Area Development from 1965 to 1968. He also has been a member of the Agricultural Committee of the National Planning Association.

A native of Arkansas, Dr. Maddox received his B.S.A. from the University of Arkansas in 1927, his M.S. from the University of Wisconsin in 1930, and his Ph.D. in economics from Harvard in 1950. In addition, he studied at the London School of Economics.

Walter William Wilcox
Legislative Reference Service, Library of Congress
Former Director of Agricultural Economics, U.S. Department of Agriculture
Former Assistant Chief of Division, War Food Administration

WALTER W. WILCOX, with his brilliant concepts and searching analyses, has had a stimulating as well as a moderating influence upon agricultural legislation and policy for two decades. His skill in adapting the technical, objective knowledge of the agricultural economist to the conflicting needs of the legislator and administrator has caused his advice to be sought at every level of government. His books and other writings have enlarged the views of a generation of students and scholars.

His outstanding competence in farm policy stems from a foundation of significant research. His first writings, reporting the results of research in farm management and production economics, reflected an awareness of the human factors in agriculture. This humanistic interest has given his work a vitality and reality transcending theory and its application. Much of his research in this area was distilled in his work on social responsibility and farm leadership.

His research in the field of agricultural prices, which again has contributed to theory and its application, has also clearly reflected his humanistic views. He has shown that agricultural prices are intimately related to types of production and farm holdings. He has then posed, in clear, unequivocal language, the alternatives open to America and their possible effects upon rural life.

More recently, he has emphasized the relation of nutrition, both on the national and the international scene, to production economics and to farm policy.

Born on an Iowa farm in 1904, he earned his B.S. degree at Iowa State, his M.S. at the University of Illinois, and his Ph.D. at Harvard. After beginning his professional career in the Bureau of Agricultural Economics, 1930–35, he served on the staff at Iowa State University, 1935–42, and then was with the War Food Administration. He taught at the University of Wisconsin, 1944–50, and from there went to the Legislative Reference Service of the Library of Congress. He was appointed Director of Agricultural Economics of the U.S. Department of Agriculture in 1967 and resigned from that post in 1969 to return to the Library of Congress.

In 1956, he undertook an assignment in Chile for the Food and Agriculture Organization. He has also undertaken short-term teaching and research assignments for several universities and organizations. For many years, through the USDA Graduate School, he has offered a seminar in agricultural policy for leaders in policy development and implementation. He edited the *Journal of Farm Economics* from 1949 to 1951.

DALE E. HATHAWAY is chairman of the Department of Agricultural Economics at Michigan State University, where he has been a faculty member since 1948. At Michigan State he has been engaged in teaching and research in agricultural price and income policy, labor mobility, rural poverty, and agricultural political processes. He has served as a senior staff member of the Council of Economic Advisors and as a visiting professor of economics at the University of Chicago. He has served as a consultant to the Commission on Food and Fiber, the National Advisory Commission for Rural Poverty, and the United States Department of Agriculture, the United States Department of Labor, and the Council of Economic Advisors. Dr. Hathaway is the author of two books, *Government and Agriculture* and *Problems of Progress in the Agricultural Economy,* and has published numerous research bulletins and journal articles. He won the AAEA award for best published research in 1956, 1958, and 1967. He was a member of the Editorial Council in 1958, 1959, and 1960 and was vice-president of the Association in 1962-63.

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The Economics of Agricultural Economics*

DALE E. HATHAWAY

As an economist addressing other economists, it seems natural to me to use our basic analytical tools as a framework for discussing future challenges to our profession. Thus, an evaluation of the supply and demand for the services of agricultural economists seems to me to be an interesting and useful intellectual enterprise. In a time of rapid change, the probability of failing to anticipate major market shifts and adjust to them seems great. For economists, such a failure would be inexcusable. The stories are legion about physicians too busy to notice their own health problems. It would be unfortunate if we were too preoccupied to apply a modest amount of economic analysis to the services we supply—just as we analyze such factors.

I am concerned today about the well-being of the profession; I am concerned because I believe that a relative decline in our position would reflect our failure to meet adequately the needs of the society we serve. This is not to imply that the market test of a profession's performance is the only valid one, but we cannot ignore such a test in an economy responsive to consumers of both public and private services.

My underlying assumption is that science–social or otherwise–exists to serve man and not vice versa. Thus, it is my belief that our success and ultimate rewards will be related to our ability, as a profession, to provide meaningful answers to mankind's important problems in the decades ahead.

The impetus for these thoughts initially came from two sources. The first was T. W. Schultz's stimulating Fellows lecture at the 1968 annual meeting [4]. His theme involved the application of traditional supply and demand analysis to institutions. My parallel regards the supply and demand for professional services, some of which are profoundly affected by our institutions and the changes or rigidities in them. It assumes, however, that such institutions are within our control and that our supply of services is thus largely self-determined.

The other stimulus leading to my discussion was the report of three

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* I have benefited greatly from the comments of L. L. Boger, James T. Bonnen, Glenn L. Johnson, Lester Manderscheid, James D. Shaffer, and John A. Schnittker. Miss Kathleen Wilk provided the statistics underlying parts of the analysis.

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studies of economists' income, inaugurated by the American Economics Association and published in December 1968 [6]. One study indicated, somewhat to my surprise, that economists' salaries were second only to mathematicians' (by a very narrow margin), taking into account factors such as age, type of employer, years of experience, etc. This is in sharp contrast to the agricultural sciences, with which we are often closely associated. The agricultural scientists have the lowest income of any of the professions, taking all factors into account, and are more than one-fourth below economists [5, p. 56, Table II-4]. Among economists, agricultural economists do not fare quite as well as monetary specialists, but the differences among the specialists in our discipline are modest (ten percent) relative to that between disciplines or between different employers of economists.[1]

All this suggests that we must be doing very well indeed for the public to have rewarded us so well as a profession. Even so, I judge the market to be shifting rapidly as a result of profound changes in our society, and I doubt that the services that were adequate in the past will meet the demands of the future.

In this respect it is important to differentiate between need and effective demand. The willingness to pay for professional services arises because it is demonstrated that the service can satisfy a need. Organ transplants in medicine are a case in point, for I suspect that the effective demand was completely absent until the medical profession proved it could provide a useful service. Now, apparently, the demand far exceeds the available supply of such services and the associated donors.

My general proposition can be stated simply: We have enjoyed an extraordinary demand for the services of agricultural economists in recent years. However, it is unlikely that the demand will be sustained for our present services. Thus, our future depends upon our willingness and ability to provide new and expanded services to meet the rising demands for services relevant to the major problems of our society. My belief is that certain internally imposed impediments stand in the way of our providing these services. The nature of the services demanded and some barriers to providing them constitute the bulk of my discussion.

It appears useful to reduce the aggregate concept of services to groups of relatively specific services: teaching, research, adult education, advisory and administrative services. Here we find substantial interdependence, for teaching affects the long-run supply of all the other services; current research services affect the subsequent services available in adult education and public and private policy making; and public and private policy making and administrative services affect the current and future demand for teaching and research services. Thus, we have not a simple set of independent supply and demand factors to look at, but instead, a large complex system that even elementary logic suggests requires analysis of a complex set of relationships. However, having said this, I shall proceed like most model builders to ignore most of the interdependence and attempt to discuss parts of the system as independent relationships.

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[1] For instance, the mean net salary difference between teaching and management employment within economics was 22 percent and between B.S. and Ph.D. holders was 22.5 percent.

University Teaching—Undergraduate and Graduate

One ought to begin with the teaching services, for this and the associated processes of student selection, education, and placement are major determinants of the form and quality of services available to provide other services in subsequent years [3]. Some argue that our teaching services merely attempt to meet derived demands, but since few, if any, groups in society are more inner-directed than university faculties, I think this argument less than convincing. If there is truly an independent short-run supply function, it is in university education, for what is taught most generally is what professors perceive students to need, which often differs from the perceptions held by students and their future employers.

The demand for university level undergraduate instruction has grown fantastically in the past decade. For instance, the 1967 fall term enrollment in all undergraduate and first year professional programs in the United States was 240 percent of its 1955 level. Over the same period, the undergraduate enrollment in colleges of agriculture rose only 43 percent and that in agricultural economics by somewhat less.[2]

Even this casual examination of the statistics indicates that it is *not* the demand for undergraduate teaching services that has maintained the market for agricultural economists. While we have fared better in this regard than some of our colleagues in the agricultural sciences, we have not shared proportionately in rising university undergraduate enrollment—a factor that has been a major determinant of the demand in other branches of economics.

One trend in undergraduate programs is clear. In contrast to the situation reported by Nichols a decade ago, there has been a significant increase in both quantity and quality of undergraduate work in economic theory and quantitative techniques in recent years. In fact, many of our present undergraduates in agricultural economics possess a sophistication in these areas that was found generally only in the completing doctoral student of a quarter of a century earlier.

There are two reasons for this advance. One is the steady upgrading of the quality of secondary education of our undergraduates. The second is the increasing concentration in our curriculum upon social science and mathematics and the steady decline of technical agriculture. Prior to World War II and for a time thereafter an undergraduate degree in agricultural economics was often a thin veneer of social science over a large base of applied agriculture. Today, many undergraduate degrees in our field consist of large blocks of mathematics and social science held shakily into the form of an applied field by the thin mortar of a few technical agricultural courses.[3]

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[2] The latter figure is based upon degrees granted, since the figures on undergraduate enrollment by major are questionable when available.

This marked change in undergraduate training appears to be a mixed blessing. On the one hand, it produces an input for graduate study in agricultural economics that more easily fits our standard graduate program. It also may provide a curriculum more appealing to urban-reared undergraduates, who often are both fearful and condescending toward courses in applied agriculture; but if the new curriculum is appealing to them, this attraction is not reflected in a tidal wave of enrollment.

The other side is that our increasingly specialized undergraduate programs may become less relevant to all but those preparing for graduate work in ours or a closely related field. The absence of either technical agricultural or humanizing courses may lead both to a less appealing undergraduate curriculum for the student planning to end his education at the bachelor's level and to entering graduate students who are better prepared to use the tools of the trade but with little idea of the important problems or the contributions that our analytical tools can offer to their solution. Thus, the lagging demand for our undergraduate programs may arise from our failure to recognize that our undergraduate training in the sciences, including social sciences, is designed primarily to professionalize and not to humanize. I believe that both can be done in an undergraduate program and that we would then have a superior product for both graduate study and the employment market.

There is one area of undergraduate training where we have clearly failed to meet the needs of society. At a time when the demand is for more attention to university recruiting and training for low income and minority groups, agricultural economics still draws its students largely from white middleclass families, especially those looking for a way out of rural employment. As economists, we have advised everyone else to look at resource allocation, and as policy advisors we have long decried the inadequate resources allocated to educating the disadvantaged in our society. Therefore, it is somewhat ironic that so few of the resources that we control have been allocated to recruit and train young people from disadvantaged groups. At one time colleges of agriculture, including agricultural economics, were important avenues of upward social and economic mobility for rural young people, although this was never true for minority groups. I believe it is imperative that we move rapidly to meet these demands with new resources and new concepts, much as we have done in training foreign students.

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[3] For instance, a survey of the 1969 Michigan State University faculty in agricultural economics shows that those with their B.S. prior to 1950 had the largest block of hours in technical agriculture, with 24 percent as many in mathematics and statistics and 70 percent as many in social science as in agriculture. Conversely, domestic graduate students applying to Michigan State University in 1969 had more than twice as many hours in social science as in technical agriculture and two-thirds as many hours in mathematics and statistics.

It would be unreasonable to expect that we can or should have a greater demand for our undergraduate teaching services from any group unless the services provided are of value to the recipients. They will not be of value unless we recognize that our society is no longer predominately rural and that our food and fiber industry is no longer predominately on the farm. C. E. Bishop covered this point most thoughtfully in his presidential address [1]. We still are not adjusting our undergraduate teaching services sufficiently to recognize it.

Graduate Training

In contrast to undergraduate programs, where degrees granted in agricultural economics have risen less than a third in the past decade, the demand for graduate training in agricultural economics has risen rapidly, with enrollments up more than two-thirds in a decade.

Even this is misleading, however, for the master's degrees granted annually in agricultural econmics have risen less than 20 percent over the past decade, whereas doctorates have almost doubled. One has to ask, then, why has the demand by students for doctoral training in agricultural economics been increasing so much more rapidly than for lower degrees?

Part of it can be explained as a straightforward response of students to the return on the additional investment. A B.S. in agricultural economics probably has less market value than a B.S. in many other sub-fields of economics. In the United States, at least, the value of the master's degree is only a little above the bachelor's degree in economics while the Ph.D. offers high returns to the individual, especially if its cost is kept low to the individual by fellowships and research assistantships.[4] But I believe that the demand for advanced training goes beyond monetary motivation to the belief that we are training persons to offer *useful* social services.

The rising demand for graduate work in agricultural economics appears to have three roots: (1) the demand for graduate training for foreign students; (2) the demand created by persons headed for a university or government research career, especially in the field of international development; and (3) the demand by those preparing for a career in the business world. Beyond these is the continued public and private demand for people from government and universities for administrative and policy making roles in both the public and private sectors.

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[4] The American Economics Association survey indicates that the master's in economics adds only six percent to net salary over a bachelor's degree.

Much has already been written about the suitability and quality of our graduate training for foreign students. I shall not engage in that discussion here but wish to point out a possible long-run demand shift for graduate training of foreign students. If we are at all successful in our institution-building projects abroad, the current level of demand for training foreign graduate students is not likely to be sustained. It appears probable and desirable that many of the master's students, and eventually a major portion of the doctorates in agricultural economics will be produced in foreign national or regional universities. We should remember that 50 years ago it was fashionable and desirable for Americans to get their graduate training in economics in British and continental universities, whereas such training now is relatively rare, presumably because the quality of our own training has improved. Moreover, as the relative gap between professional salaries in foreign countries and the United States closes, the value of a United States degree as an entry to our professional labor market will diminish.

A second expansion factor has been the graduate training necessary to upgrade the university and government staffs in agricultural economics and to fill the demands for foreign development assistance programs. The former passed its peak by the mid-1950's; it is possible that the latter has also peaked, as trained foreign students become available to meet the demands for agricultural economists in their own countries.

There is inherent in this an accelerator principle: We expanded staff to expand training of graduate students, which in turn created the demand for more graduate work, and so on. If that is the case, there also is the potential accelerator effect of a decline in one or more of these sources of demand and the possibility of serious overcapacity in graduate training facilities in the United States. This possibility is enhanced by the continued entrance of new institutions, with exit so rare as to be almost nonexistent. Since the unit cost of graduate training falls sharply as numbers in a single program increase, we may well face a problem of high cost programs (relative to other fields in economics), which may be especially troublesome in some institutions.

Prior to World War II, the major suppliers of Ph.D.'s in agricultural economics were a few—but a very few—land-grant universities and three or four well-known private universities. The situation now is very different. The largest producers of Ph.D.'s in agricultural economics are now the land-grant universities, and production is widely distributed among them. The major private institutions have declined both in absolute and relative terms.

The strengthening of graduate training in theory and quantitative methods seems almost universal; without it the shift in location might not have occurred. Emphasis on economic theory, quantitative methods, and analytical tools is widespread, whereas it was previously the hallmark of only a few institutions. This change is evident if one only looks at minimum Ph.D. requirements in most institutions; and, unpleasant as it may be to those of us trained in an earlier period, I believe it accounts in part for the steady narrowing of price differentials between new Ph.D.'s and those trained more than a decade ago who now may be suffering from technological obsolescence.

I would not want to end this discussion of graduate programs on a pessimistic note, for there are areas in which the demand for graduate work is expanding. One of these is the great need and potential demand for graduate training for persons from disadvantaged groups in the United States. We have too long used excuses about inadequate undergraduate background, weakness in verbal skills, etc., implying that the supply of potential candidates was lacking. If we had adopted the same attitude toward training foreign graduate students, those programs would have failed completely. If we will put as much effort into selection, preparation, and retention of students from our own minority groups as we do in the typical Asian or Latin American graduate student, we can attract and train much larger numbers from our minority groups without reducing degree requirements.

The greatest potential demand for graduate work in agricultural economics will be generated by the demand rising from new balance in our social science research and advisory programs. Webster (3rd. ed., unabridged) defines social science as "concerned with the welfare of human beings of society." During the last quarter of a century we have made tremendous strides in putting the *science* in our social science. Having done this, I believe we should now put additional emphasis on the *social* in our social science. Do not misunderstand me. I am not advocating a return to the prewar graduate programs lacking in adequate economic theory, mathematics, and statistics. But, just as there is no "welfare" in welfare economics, many of our present activities have little "social" in their orientation. Among other things, the younger generation is saying that our society should insist that science is used to achieve social goals, and I tend to agree. Unless we emphasize this in our graduate training and in our research and advisory work, we may find our graduates unable to meet the demands of society. Eventually, our graduate programs will fail to attract the best young people, and we will face a situation most difficult to reverse.

Research Services

In general, the demand for research services from agricultural economists has grown rapidly over the past quarter of a century and so has the supply offered. The supply has been greatly enhanced by the marked advance in training and equipment. Yet, as one views the problems of the world, there appear to be large areas of demand for research that are met inadequately and that should receive our attention if we are to contribute at a level anywhere near our potential. Let me spell out some of these demands and the changes needed to meet them.

The demand for research on aggregate policy questions

Increasingly, in response to requests of policy makers, our profession has applied quantitative research techniques to provide estimates of outcomes of alternative policy actions. This work has had a major impact on policy and has brought demands for more policy research. Of course, such research has not escaped criticism, especially when its results have been sharply at variance with the firmly held opinions of major political forces. Nevertheless, the demand for more and better policy research continues, but our policy research and its results are not adequate to meet the need.

So far our research has not dealt adequately with many of the major policy issues of deep concern to farm people and the larger society. We have offered little in research results on these issues: who should control the food and fiber industry; what are the total social costs and returns from different methods of organizing the industry or its subsectors; who does and should get the benefits from our expensive government programs; what is the most desirable distribution of our economic growth and population; how can we achieve a desirable physical environment in which to live and work; what trade policies will meet the multiple goals we have with respect to the rest of the world. Moreover, as Bishop pointed out, our policy models are still largely restricted to agriculture, with too little attention to inter-sector relations and to issues beyond economics.

Research on agricultural systems

Many observers, including my colleague, James D. Shaffer, have commented on the increasing interdependence and closer linkages between the various segments of the food and fiber industry. It is no longer correct to assume that the various sectors of the industry are interconnected by a series of perfectly competitive markets. And, once this assumption is dropped, it is no longer sufficient to do research on input producers, farms, marketing firms, and retail outlets as independent units. What is needed, and is increasingly being demanded for both public and private policy making, is an analysis of food and fiber systems. Business has known this for some time, and there is increasing recognition from farm leaders and policy makers concerned with the problems related to the industry's structure and performance, bargaining, and resource ownership and control.

Research on new institutions

James Bonnen has described the decline of the agricultural establishment in his prize-winning journal article [2]. In essence, he says that the old agricultural institutions, judged by their behavior, are no longer functional to meet the needs of present-day society. James Shaffer's recent paper expands and explores different aspects of this theme [5]. Our campuses—and indeed our society—are being torn apart by issues of the inflexibility of old institutions and attempts to build new ones that will function more effectively.

If one talks with rural people or their leaders, we find that they are acutely conscious that their local institutions—churches, schools, local government, cooperatives, farm organizations, etc.—are unable to deal with today's problems. While their immediate attention often focuses on the institutional barriers to solving their local problems, it should be noted that even at the national and international level, the pressing problems they see are the need for different international trade arrangements, greater farmer bargaining power, improved status of farm labor and the other rural poor, and new ways to revitalize the economic and social structure of rural America. Each of these involves major institutional innovation.

The demand for research and information on such subjects appears to be very great, yet little supply seems to be forthcoming. In some ways this is surprising, for an entire generation of great names in agricultural economics achieved recognition because they made contributions to solving problems by building new institutions. One only has to think of institutions like the Farm Credit Administration, the Farm Security Administration, the AAA, the BAE, price support programs, and land use planning to bring to mind literally scores of agricultural economists who played a prominent role in the design of these institutions, both from within and from outside. Frankly, I see too few people of equal ability and imagination concerned with such issues now. Conversely, as Schulz suggested, work on institutions without regard to the problems that the institutions must resolve is likely to prove unproductive.

Applied development research

There is, I think, a substantial demand both here and abroad for significant problem-solving research on development problems of poor countries. This demand is not being met adequately, but do not take this as an assertion that our profession has not made significant contributions abroad in a variety of roles. I am merely saying that our research contribution has not matched our resource capability.

Rarely do we find research that is addressed to the broader problems of a developing country, involving the allocation of very scarce resources and the results in terms of growth rates, income distribution, political implication, and the time path that is so important in countries tottering on the brink of economic or political disaster. As in domestic research, too little attention is given to the interaction between the rural and urban sectors.

Some characteristics of unfilled research demands

The research needs I have cataloged, only partial at best, reflect a pattern that must be recognized if we are to fill these demands.

First, most of this research is problem solving and requires going far beyond our common analytical models and tools. Almost always it involves dealing with complex value problems and political issues, and a Pareto-better solution is unlikely to be found. This leaves us frustrated as theoreticians, inasmuch as there often is no common denominator to deal with, and thus we cannot maximize over various alternative actions. Moreover, in most cases the decision rules (institutions) are not even agreed upon or known, so that the issues we usually assume fixed are among the most important variables to be dealt with.

Second, these problems are multidisciplinary (almost by definition), with the economic variables subject to change as a result of shifts in other variables.

Third, these problems generally involve many aspects of society, not just the sector we delineate as rural or farm.

Fourth, because of their scale and complexity, these problems generally require a large-scale critical mass of research effort in order to achieve meaningful results.

Barriers to providing the needed research services

As I see it, three major barriers prevent our offering the needed research services: (1) our increasing tendency to associate a single philosophical method (positivism) with scientific endeavor in the social sciences, (2) our inadequate administrative and institutional arrangements in research establishments, and (3) our long cherished belief in professional independence. Let us look briefly at each.

Our continued drive for better economic theory and for improved quantification has led us increasingly to the position that science does not deal with normative issues. This, of course, precludes dealing with values, non Pareto-better solutions, or matters lacking a common denominator.

We have few political economists any more, either in training or practice, and there tends to be a subjective professional downgrading of those willing to act as such. This issue has, of course, been widely, though sometimes obscurely, debated in our profession from time to time. My position is that we should not adopt research methodology that is too restrictive to allow us to meet the major demands for social science research. I would argue that being useful and relevant is more important than respectability, especially if the respectability is defined by an artificial set of rules promulgated to justify how the majority of the profession has decided it wants to act.

Our institutional and administrative research arrangements are almost entirely discipline oriented and, moreover, oriented to relatively small units of professional input. Thus, we lack the organization necessary to do either multidisciplinary or multiunit research. If the needed research is to be done well, most of it must be multidisciplinary, involving technical as well as economic relations and other social sciences. Our traditional organizations have not been very successful in developing such research teams.

Efforts to use regional research mechanisms to overcome this problem thus far have not been notable for their success. The interregional research mechanism has fared little better. Moreover, with few exceptions, the regional projects have been disciplinary in focus rather than multidisciplinary. One reason for the rapid growth of private research organizations appears to be their superior ability to put together research teams appropriate to tackle these kinds of problems.

Our research on foreign development problems has been especially handicapped by our inability to develop a viable overseas research mechanism based on United States funds and manpower. As yet, no institutional arrangement has been developed that will provide the long-term funding, overseas base, and professional rewards comparable to our domestic research programs. Overseas research problems have been compounded recently by a rising political aversion in the United States to foreign aid, in which research tends to be lumped with other forms of assistance. We have seen indications that the new directions in US/AID may solve this problem in part, but it will take far more than substantial block grants to solve the many problems involved.

The third barrier to our effective supply of needed research services is largely derived from our internal professional image. Since our profession developed during a period of laissez-faire, it is perhaps only to be expected that our research organization consists primarily of a large number of individual entrepreneurs (often on public payrolls). We now are primarily a collection of individuals, producing small bits of analysis that we hope will be demanded in the marketplace of ideas. The research system is typified by small individual projects, an individual reward and promotion system, and by the American Agricultural Economic Association's system of recognition of *individual* research and journal articles. It has been fortified by (or has produced) a professional view of "every man a king" or "all chiefs and no Indians" in that research teams are viewed with suspicion, if not with alarm, by everyone from the new Ph.D. to the most senior professor. If the auto manufacturers followed the same principle, several companies would ship the buyer a variety of car parts, which might or might not fit together to be assembled without instructions. There are some who would assert that this might produce a product superior to that now available, but this approach assumes tools and skills not generally possessed by consumers of either cars or research; and it ignores the concepts of complementarity and scale that are so popular with economists when applied to the activities of others.

These impediments are self-imposed by our training, our professional views, and our self-made institutions, and therefore should be entirely within our power to change. Certainly they present far fewer difficulties than the well-entrenched outside political institutions. The question is whether we clearly see the need for change.

Adult Education and Advisory Service

Historically, the demand for advisory services on organization and management problems of individual farms and marketing firms has been a major source of demand for services of agricultural economists and the cornerstone of public support for our teaching and research programs. To some extent, these services have escaped some of the issues that have inhibited our research work on other problems, partially because some of the issues are absent. Such work has been multidisciplinary, for most workers in the area recognized that these problems were broader than economics. Moreover, we have either used the goals defined by the demanders of the service or helped them develop new goals, often ignoring the conflicts between these goals and those of society at large. And, until recently, the firms involved have been sufficiently small that individuals or small teams could adequately handle their problems. But in this area, as much as in any other, the major structural shifts in the food and fiber industry are leading to demand shifts with possible long-run implications.

What are the demand implications for our farm management and marketing programs of the steady drift toward an industrialized food and fiber industry with large-scale production units, often owned or tied to large nonfarm industries by contact and other devices? What are the demand implications for our services of the prospect of organized farm labor, commodity-wide producer bargaining, and full-supply contracts for inputs? These shifts will create most of the conditions that have hampered our effectiveness in problem-solving research, for advisors will then have to deal with value conflicts, scale problems, and greater interdependence with other segments of society.

How will we meet these new demands? I have no answers to these difficult questions, but I believe that serious analysis is overdue. We have for years told producer and marketing institutions to reorganize and to adjust to change in demand if they expect to survive, yet we seem to be doing little of the basic thinking necessary for us to reorganize our own supply of services.

In the area of domestic work with the rural poor and community development, as well as price, income, and trade policy, we have been less than completely successful. This is not altogether surprising, since advisory work in these areas has the same characteristics as research work and suffers from many of the same impediments in philosophy, organization, and intellectual independence. Moreover, work in these areas has been impeded by our concern with the political power of the traditional agricultural establishment and its belief that such work is competitive with the interests of the commercial food and fiber sector.

In the quarter century since World War II, a major expansion has occurred in the demand for education and advisory work in developing countries, manifested largely through American foundations and United States government agencies. Initially, the demand was heavy for persons who could deal with micro problems, especially relating to farm production. As on the domestic scene, those involved have avoided some of the pitfalls mentioned earlier and have worked on problems as they arose, but this work has suffered substantially from inadequate administrative-institutional arrangements.

The supply of services offered to meet this demand has been uneven in quality. Perhaps most important, however, has been the short-term basis of the services. The reasons for this have been several: (1) The majority of United States institutions have regarded foreign work as auxiliary at best, and more often as competitive to their ongoing domestic programs. (2) Many of the individuals concerned have felt (probably rightly) that their professional prospects were brighter if they combined foreign and domestic work instead of becoming career persons in overseas work. (3) The overseas worker has been forced to operate without the necessary research base.

Problems on the supply side have been related directly to uncertainties created by the demand. As yet, no successful administrative model has been developed to provide the demand stability sufficient to induce major institutions to supply the total package of services needed. Thus far, the most stable element of this demand has been the direct hire program of the foundations and government, but this often lacks the research ties and the intellectual interaction that might be provided by the universities, the Economic Research Service, and private business.

At the present time there is a fundamental shift under way in the level and nature of the demand for overseas advisory services. For a variety of reasons, the level of demand from both the United States government and the foundations has declined recently, and its future level from each is uncertain. And the nature of demand is shifting toward a new type of advisory service with the somewhat belated recognition that significant problems of macro-policy nature may be crucial in determing micro-firm actions. This demand is being accentuated by the increase of "second generation" problems engendered by some technical breakthroughs in production. Increasingly, these will involve matters of scale, interdependence, and extraordinarily difficult value questions and political issues.

It appears that both government and foundations are recognizing these problems and that some stabilization and expansion of this demand may be expected in the years immediately ahead. If so, it will then be up to us, as individuals and as participants in institutions, to prove that we can provide the necessary services.

I am hopeful that the instability on both the demand and supply sides will subside rapidly and that a new set of relationships can be established. It is inconceivable that those hoping to build new institutions around the world cannot develop adequate institutional arrangements at home to do the job.

Administrative and Policy-Making Services

The demand for services of agricultural economists has expanded most rapidly at the administrative and policy-making levels in universities, business, government, and international agencies. At the upper levels in the Department of Agriculture, economists are replacing professional politicians and farmer-leaders. A large number of land-grant university presidents and vice-presidents come from our ranks, and the proportion of Deans of Agriculture from our ranks is as pleasing to us as it is irritating to our colleagues in other agricultural fields. We find our colleagues in business doing very well and the demand for agricultural economists in business seems to be still increasing. Indeed, without this heavy demand for administrative and policy-making services by agricultural economists, the market might be very depressed, given the relentless, self-powered supply of new entrants to the field. The questions then are: What created this demand? Will it continue to expand?

A major factor in the continued demand for agricultural economists in administrative roles is the generally outstanding performance that our profession has exhibited in them. Even though our research and teaching emphasis has become increasingly discipline oriented, agricultural economists in administrative and policy-making roles continue to be problem oriented and recognize that many factors outside economics need to be considered.

If my analysis regarding trends in our training is correct, it raises an interesting question for the future supply of such services. Are we, in our drive for more intensive disciplinary training in economics and mathematics, in danger of so narrowing the focus of our graduates as to reduce substantially the likelihood of their making future contributions in policy-making administrative roles? And has our scientific image become so important to us that we are no longer willing to participate in public service at some possible sacrifice to our "scientific" careers? These are, I think, especially crucial questions in our training of foreign students, who because of their training, are likely to have opportunities for important administrative positions, often soon after completing their graduate work.

Conclusions

Based on the market test usually applied in our economy, agricultural economics is doing well. The returns for our services are high relative to most other professions, especially so relative to our colleagues in the agricultural sciences. My contention, however, is that this should give us little reason for complacency because much of our current well being may be due to demand factors that will not continue.

Since World War II, we have made substantial improvements in both our theory and methodology. These have been reflected in shifts in our undergraduate and graduate training and in our research and advisory programs. The ground work is well laid for either continued advances and contributions or for a retreat to a narrow focus that will limit our contributions to society.

To accomplish the things that will be demanded will require major institutional and professional adjustments on our part. We must examine critically our philosophy of science, our administrative structures, our systems of small individual research projects, and the future utility of our almost complete intellectual independence. We also must examine carefully our political support and related financial base, which is increasingly tied to commercial agriculture, and, moreover, to a rapidly disappearing segment of that. I am not suggesting that we abandon our service to commercial food and fiber producers, but that we broaden our services and our political and economic support far beyond them.

Twice in my more than two decades in this profession, I have seen the farmers in this country lulled into the belief that the market demand for their products was unlimited and growing, only to be rudely shocked back to reality by shifts that were in line with the long-run world supply and demand for food and fiber. Even though the civil service and university tenure provide a comfortable price support and storage program for agricultural economists, I would hate to see our profession compelled to fall back on these because we have failed to anticipate and adjust to shifts in demand.

Ultimately, our success as a profession will rest on how we define our potential role in society and on the services we are willing to provide society under this definition. To have continued success, I believe we must combine two basic elements—an even greater excellence in our training and practice as economists and a willingness to apply our economic tools in our teaching, research, and advisory work as parts of new groups in organization and scope, with sufficient scale to help solve the significant problems of society.

I am optimistic, for I believe that in this context the potential real demand for our services is very high; and if we adjust our services to meet the demands, we should prosper. If in one or two decades we find ourselves in a relatively less favorable position than now, it almost certainly will be due to our intellectual and institutional rigidities, not to society's lack of need for our services.

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A Future for "Agricultural Economics"?

James M. Buchanan

I shall preface my remarks with a relevant and deserved tribute to the late Professor Wilson Gee of the University of Virginia. Gee was a prophet without honor in his own university, and it is fitting that I pay him tribute here among some men who may have known him. Gee came to Virginia early in the 1920's and, after a dispute with other economists, he split off and established his own department which he called "Rural Social Economics." Almost single-handedly he developed a Ph.D. program which awarded some 20 degrees over a thirty-year span, some of whose recipients remain leading educators and public officials today. Apart from all this and complementary to it, Gee secured external funds, established an institute, published twenty-seven books through its auspices, and forced the state legislature in Virginia to include an annual appropriation for social science research. The latter remains a mighty achievement today; you can imagine the odds against Gee in the 1930's.

My reference here to Wilson Gee is not opportunistic or passing. I shall argue that one future for "agricultural economics," as a scholarly subdiscipline worthy of continuing public and private support, and especially in land-grant universities, is provided in the approach that the title of Gee's now-defunct department suggests, "Rural Social Economics."

Before getting into my central argument, however, let me clear the air by stating briefly my own views about disciplinary and subdisciplinary classifications. I have never considered these to be of much import, and one of my personal criteria for evaluating an administrative unit is its willingness to discard and forget about "fields" and "areas." I have never been impressed by the departmental chairman or recruiting officer who says that we must fill a vacancy in "labor," in "trade," etc. The various subdisciplines in economics seem to me more or less arbitrary, in any case, and dependent more on accidents in academic history than on anything else. Good economic theory can be taught, and students can be trained to apply it, under a host of rubrics, including many not yet dreamt of in our educational philosophies. Hence, I do not mind very much when new courses are proposed in areas that attract current topical interest, provided only that the economics is rigorous and that the instructor is competently and professionally trained, in attitude as well as in technique. I see no cause for alarm when proposals are made for courses and specializations in such things as "economics of poverty," "ghetto economics," or

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"defense economics," "economics of development," or "urban economics."

Having stated a general position, let me hasten to add that I recognize, to the extent possible for an outsider, the special characteristics of "agricultural economics" that make the problem of preserving its importance as an independent subdiscipline more significant than many of the other fields or areas. Within a single organizational unit, normally a department, fields or areas of instructional and research specialization may be added, dropped, transformed, although admittedly sometimes with great difficulties and with long lags between desire, decision, and action. "Agricultural economics" is, however, different precisely because in most universities, it is organized independently as a self-contained departmental unit, often located in a wholly different school or college from that which houses the more inclusive discipline of economics. What is the future for "agricultural economics"?—this questioning form of my title takes on more substantive content when this peculiar institutional independence is acknowledged.

I want to make one further point by way of introduction. I shall presume that there does exist doubt and fear, at least on the part of some, concerning the long-term viability of the subdiscipline's status. Implicit in the willingness to raise the question about the future must be the hope that, with proper foresight and planning, followed by responsible action, the long-term prospect need not be the gradual decline-demise that straightforward projections embody. On this score, my paper can, I think, be taken to be optimistic. Properly transformed, the subdiscipline can reestablish itself as a vital center for instruction, research, and scholarship with an emphasis on orientation that is currently largely ignored and overlooked. It is this new emphasis that explains my initial reference to Wilson Gee. I want to suggest that a future for "agricultural economics" lies in its transformation into something that might appropriately be called "rural social economics," or simply "rural economics," or, if you do not like this, "non-urban economics." This can be an area of fascinating scholarship in the decades ahead, and major contributions are waiting to be made. The transformation can be accomplished without great difficulty, although of course after some time lags. The transformation would be, I assert, not only in your own interest as professionals in a subdiscipline but also in the interest of us all as citizens of the America of the 1970's. To justify this assertion, I must first digress briefly into the sometime murky regions of methodology.

What Should Economists Do?

Since I have elaborated my position elsewhere [1, 2], I apologize to those who must be subjected to repetition here. Baldly stated, my position is that economics as a social science is more than applied mathematics.

Far too many currently practicing professionals in economics, both in the parent discipline and its various applied fields, act as if there is nothing more than applied mathematics in it after all. Commencing with Robbins' definition of the "economic problem," they spend all of their energies working on variations of simple maximization and minimization, on allocation and efficiency, whether this be at the level of the individual choosing agent, the consumer, the producer, or the firm, or at the level of the community-collectivity acting through political-government processes. The procedure is all too familiar· Once an objective function is specified, the constraints are introduced, and away we go with the simplistic manipulation of everyday mathematics. Advances are hailed when we "solve" more complex problems, which are introduced by making our constraints mathematically more intricate and more complicated. All of this would be bad enough if we stayed at the level of the single utility-maximizing consumer or the single profit-maximizing firm. It becomes near-ludicrous when the same procedure is extended to "public choice," to the economic problem that is presumably faced by the whole community. Here economists often adopt a ridiculously arrogant position by hypothesizing implicitly that they are appointed as all-powerful despots. Once this step is taken, the routine is carried on as before. Objective or target functions are specified, constraints are defined, and on we go with solving all of our "social ills." Is it any wonder that economists remain shocked and bewildered when ordinary politicians, who necessarily respond to public demands, refuse to accept their proffered solutions?

I should emphasize that I am not questioning the efficiency of applied mathematics, or indeed that of engineering in any of its forms. The role of the engineer is an honorable one, and without engineers, where would our theorists be? But I do object, and strongly, to the confusion between economists and engineers. By a coupling that has had some tragic educational implications, economics is often institutionally paired with business administration which, properly handled, can be a legitimate area of engineering. Many economists would, of course, join me in these strictures against the association of economics with the maximizing skills of business firms. But, unfortunately, many of these same economists then will happily devote most of their own energies to telling us all how governmental or public policy "should" be arranged. On this I want to be clear; "social engineering" is no more a part of economics than is "business engineering" or "agricultural engineering." To the extent that "agricultural economics" is, in reality, engineering aimed at helping agricultural firms make greater profits or helping these firms to produce more efficiently, it belongs more appropriately in business administration than anywhere else. This has been properly recognized by many of the business schools, as witness the recent growth in courses of instruction in "agribusiness."

Economists, as professional social scientists, should possess a comparative advantage, not in applied mathematics, but in their expertise in a particular sort of human behavior and in the institutions that emerge from that behavior. Their task commences with Adam Smith's much neglected phrase "man's propensity to truck and barter." Men recognize that they can improve their lot by trading, and it is the economist's job to specialize in this. The institutional embodiment becomes the market, and it is the theory of markets that should be emphasized, not the theory of resource allocation. The economist remains within his professional limits when he analyzes the interaction processes through which prices are set and trades in goods and services implemented. He need not stop with organized markets. The economist is uniquely equipped to go beyond these confines and to explore man's never-ending quest for more complex and elaborate forms of voluntary cooperation. He should certainly examine the origins, emergence, and stability of institutions of all kinds, including the political. This basic methodological position justifies, of course, my own interest in collective decision making and in institutional analysis more broadly conceived.

The Economics of Agriculture

I stated earlier that the subdisciplinary classifications that exist are largely arbitrary and that good economics could be covered under many rubrics. Nonetheless, given the basic methodological position that I have outlined, we can identify some plausible schemes of classification among specialized areas of research and instruction The appropriate criteria for classification are recognizable differences in the institutional-technological constraints within which individuals behave. As an obvious example, the interaction of men in a fully competitive private-goods market process is different from the interaction of these same men in a collective-decision, public-goods, process. Technological differences in the interpersonal divisibilities of goods and services may, in part, determine the institutional patterns, but the usefulness of some subdisciplinary dividing line between the private economy and the public economy seems clear. Further subclassification within each of these two broad categories can be made, and intersecting categories can be established similarly. As a second example, men who participate in the collective sale of their own skills through the agency of labor unions behave under quite a different set of constraints from those who sell their skills independently to buyers. Hence, labor economics, as a subdisciplinary specialization has claim to legitimacy although its potentialities for scholarship do not seem to me to have ever been properly exploited. We could go further and look at the different institutional structures implied by other subdisciplinary specializations, but these need not be discussed in any detail here.

Under the general criteria of classification proposed, is an independent "economics of agriculture" legitimate? Are the institutional-technological constraints sufficiently unique in agriculture to warrant the specialization that we have observed? There is no need for serious argument on this point. The agricultural setting does generate interesting and unique economic relationships. Only a partial summary of some of its features need be listed such as : (1) the homogeneity of final products, (2) the dependence of output on natural phenomena such as weather, (3) the spatial fixity of land, (4) the exhaustibility of the land input, (5) the perishability of final product, (6) the multiplicity of producing units, (7) the pervasiveness of governmental controls, (8) the peculiarities in leasing-rental arrangements. All of these, and many more features that are no doubt more familiar to you than to me, make for particular problems in the agricultural sector, problems that surely deserve specialist consideration and treatment. (On precisely similar grounds, of course, we can justify such areas as the "economics of fisheries," the "economics of the social services," the "economics of insurance" and many many others.)

By saying that an "economics of agriculture" has a plausibly defensible existence of its own, however, I am not saying that this is where the future of "agricultural economics" and "agricultural economists" lie. As they are now organized, the latter reflect major social investments in independent research, education, and scholarship. The opportunity cost of concentrating future efforts exclusively on the "economics of agriculture" seems excessively high. This is partially because as a field of study the economics of this one industry must decline in significance as the industry itself declines. Along this route lies relative stagnation for the whole field. I think that much more inviting opportunities exist for transforming this independent discipline into something larger, while retaining the "economics of agriculture" on its own terms as an integral part of the more inclusive field. What I am proposing is that those organizational units now calling themselves "agricultural economics" become more inclusive concentrations in "rural economics," within which the economics of agriculture will remain only a subsidiary part.

Urban and Non-Urban Economics

A somewhat different way of putting this is to suggest that the agricultural economists take a leaf from the urban economist's handbook. And it will be helpful to consider briefly this rapidly developing and currently popular area or field. Can we justify the independent place for "urban economics" as a subdiscipline, in some universities even as separate department or schools? In a sense somewhat different from that applied to the earlier treatment of the economics of agriculture, I think that we can do so. With "urban economics" we are not concerned with the institutional-technological constraints imposed on behavior by the characteristic features of a single producing industry or even by a group of industries. Instead, the presumption is that the very fact of urbanization, the concentration of people in space, itself modifies the economic constraints on behavior in such a manner as to warrant specialized consideration. Commencing from the fact of urbanization, the specializist organizes his curriculum and his research by drawing on many separate and complementary subtheories in economics. His becomes a synthetic expertise, with many subtheories combined in the application to urban affairs and problems. The specialist calls on: (1) location theory, (2) land economics, (3) tax theory, (4) public goods theory, (5) theories of external economies and diseconomies, (6) theoretical welfare economics, (7) collective-decision theory, (8) transportation economics (9) public-utility economics, and perhaps several other subspecialties. If he is a teacher, his product is a student trained in basic economics, and familiar with applying this economics to the peculiar institutional setting that the urban community represents. The student is trained in what we may call an "economic understanding" of the urban community. If he is a research scholar, his product is the illumination or explanation of particular aspects of urban community achieved through a skillful application of economics.

I suggest that there is an equally legitimate area of specialization waiting to be developed and exploited in "non-urban economics," or in "rural social economics" to use Gee's appropriate term. Modern social problems are not exclusively urban, all propaganda to the contrary notwithstanding. And all rural problems are not agricultural. With a broadened specialization like "rural economics," the various subtheories or subdisciplines referred to above, along with others, could be utilized in nonurban applications. In higher education, the product would be a student trained in the same basic economics as the one who specializes in urban economics, but who is now familiar with the applications of this economics in the peculiar institutional setting of the non-urban community in its agricultural as well as its non-agricultural aspects. In research, the product would be the illumination of aspects of the non-urban community achieved through a skillful application and use of the economist's tools.

The Emerging Relevance of Rural Economics

At this point, you may be asking: Why the bother? If we are doomed to see all or substantially all of America concentrated on a few megalopoli within one or two decades, is not any concentration in "rural economics" also likely to face a continuing decline in relative significance? As we all become urbanized, what else is there left for the ruralist?

I shall answer such questions as these by a combination of assertion, conviction, hope, hunch, and hypothesis. We have, as a nation, committed a major blunder in allowing population to become overconcentrated in the cities. This has created for us social disequilibrium of a serious order, which we all must recognize. The error is only in part economic, but I think I can show that there are important economic aspects that have been neglected and overlooked. On simple grounds of efficiency, we probably need to slow down and even to reverse the migration from rural areas to the urban complexes. If I had time and space at this point, I could supply an argument on the basis of elementary economic theory that would, I am sure, convince you of this [see 3]. Let me say only that the argument hinges on the fact that individuals, in making their migration decisions, respond to average rather than to marginal product values in the public sector. The predicted relationship between marginal and average public product values in rural and urban communities strongly suggest that the optimal or efficient population distribution has been tipped too heavily toward urban concentration. Much work remains to be done to document this theoretically-based hypothesis empirically and to convince my fellow economists of my central argument.

So much by way of hypothesis. My hope is that, even for those who do not appreciate the intricacies of our science, we shall witness an accelerating revulsion against the genuine horrors of the modern city. Technology is surely on "our side" here; with rapidly improving telephonic communication especially, the positive perquisites of city life are disappearing. My hope is that we shall, as a body politic, begin to recognize that the concentration in the urban complexes is a singularly acute version of the many-person prisoners' dilemma and that we should all be better off if some deconcentration should take place. Of course, the reversal of population flows will not take place automatically, and we shall not escape from the dilemma by individually organized efforts. The congestion equilibrium of the cities may provide the motivation for increasing numbers of isolated persons to get out, but this will represent no avenue of improvement.

The urbanologists among us have dedicated themselves to the proposition that the congestion-pollution dilemma can be made tolerable by effective leadership and responsible public policy. Even the most ardent advocates of urban life rarely predict the emergence of new utopias in our cities, regardless of the success in securing federal funds. There seems to be a sort of consensus that responsible policy can, at best, prevent further decline and decay. Nonetheless, we must, as practical men and as taxpayers all, face the simple fact that we are, and very rapidly, building up an impressive academic, quasi-academic, and bureaucratic pressure group that will be able to marshall powerful and continuing arguments for the expenditure of billions in and about the urban centers.

Personally and professionally, I do not like this future that I see. I think that we can do better. And I should like to see a massive program aimed at escaping from the genuine prisoners' dilemma of the megalopolis. This program will not emerge so long as various rural development programs, not matter how well intentioned they are, are motivated primarily by the political proclivity to spread the funds around. Effective programs for genuine revitalization of American rural life can emerge, if at all, only when there is a groundswell of opinion to the effect that such programs will be advantageous to all, no matter what location. We should be sophisticated enough to recognize, however, that such a groundswell of opinion does not emerge spontaneously, as if from thin air. It must be developed, nurtured, prepared, and supported by effective academic and quasi-academic dialogue. In effect, I am suggesting that "agricultural economics" and "agricultural economists" transform themselves into the pressure group that is required for this major but exciting challenge.

I acknowledge that I am on treacherous ground here, and especially so because of the general methodological stand I have taken, in this paper and elsewhere. I cannot simultaneously say that the task of the economist is to examine exchange behavior of individuals in all of its institutional ramifications and at the same time say that economists, as professionals, should get into the political affray and begin promoting one particular set of values and objectives. Positive economic analysis and politics, whether partisan or non-partisan, do not mix, and I certainly do not want to be interepreted as lending support here to the intense and accelerating pressures for the politicization of all scholarship in the social sciences, pressures that I think are almost completely destructive, both in intent and in effect. I am not suggesting that those professional economists who are philosophically "agrarian" or "rural" in outlook should organize themselves and try to impose their own version of the world on others. I am, instead, suggesting that some professionally-trained economists, regardless of their own values, devote themselves to imaginatively critical examination of alternative institutional futures, including futures that are less urbanized than those that simple projections now indicate to be inevitable. Of course, those who consider such non-urbanized futures to be desirable will be more inclined to pursue such research. I make no naive claim that science can ever be *wertfrei* in the strict sense of the term. My emphasis is, rather, that imaginatively critical and positive analysis can be applied to non-urban institutional potentialities with possibly dramatic results. In this, I may be expressing a hope rather than a supportable hypothesis. It may be that we shall not escape from the congestion dilemma and that life in the decades ahead will be, at best, "nasty, brutish, and long," to use but a slight variation on Hobbes.

Have we really explored the external economies that are generated by the shift of retirement communities away from the urban centers? Have we examined the potentialities of dispersing our higher educational institutions, and the prospects of accomplishing this and other tasks by fiscal incentives? Why do we need to pay massive sums in aid-for-dependent children to mothers regardless of place of residence? Is not some dispersal of both the old and the young a meaningful objective when federal and state welfare outlays are made? Have we really developed systematically the welfare economics of the family? Is the existing pattern of family life in our urban center sacrosanct, or might it not be possible to move at least some distance toward the institutionalization on a year-round basis of the "summer bachelor" pattern? Has the social and economic stabilization potential of the "second home" been fully explored? And has the full socioeconomic value of the "old homestead" been appreciated?

These are only a few of the questions that might be raised and that might become legitimate areas of research concentration. Admittedly, some of the questions necessarily move beyond economics narrowly defined, into paraeconomics or into areas preempted by other social sciences. Nonetheless, it seems to me worth while for professionally-trained economists to give serious thought to these and many other alternatives. I think that economists are particularly well-equipped to provide analytical leadership in this respect. They can do so, however, only to the extent that they are willing to dig themselves out of their isolated econometric foxholes which seem uninteresting and almost totally irrelevant to those concerned with social order in the large. Despite manifold perversion, economics still supplies us with a uniquely hard-headed and non-politicized approach to social structure. This approach is needed more urgently now than it has been for generations. Without its influence, romantic fools command the center stage, with potentially disastrous consequences. (I challenge any economist who has attended a University of California faculty meeting to disagree with this statement.)

Among those professionally competent economists who have concerned themselves with the larger social issues, progress has been made. No longer do we find many of these men under the romantic illusion that ideally efficient public-governmental programs provide the alternative to market organization. Markets fail, and often notoriously so, but governmental programs also fail, and often even more notoriously. Recognition of this simple fact itself represents intellectual advance. Continued comparison and evaluation of alternative institutions must be made, and perhaps more importantly, an imaginative search for new institutional forms must be encouraged.

In my own very provisional diagnosis, men now desperately seek two related but partially contradictory objectives. They cry out for some community to which they can offer loyalty, while at the same time they seek privacy in an escape from the contiguity of anonymous fellow humans.

The nation-state, as an effective god, has failed. The churches have defiled their traditional role. New institutions have been, and will be, developed to command the loyalties of men. Few among us can look optimistically at the pattern that threatens to emerge with coalescence centered primarily on age, race, innovation in behavioral perversity, and, finally, terror. Perhaps I both exaggerate the seriousness of the portent and grasp at straws of my own prejudice. But radical dispersal of people over space appears almost to be a necessary complement to any policy of hope. Anarchy, whether this be open or repressed, cannot be tolerated in our time. The forces that make for anarchy can only be channelled constructively through significant devolution of power, through effective decentralization of authority, which must embody a spatial dimension. The apostles and advocates of bigness, of concentrated power, of centralized authority, aimed at making tolerable the human pollution of our cities, along with the scientists and scholars who give them advice and counsel will be with us, as indeed they should be. In summary, my plea is for the emergence of scientists and scholars who can become equally equipped to provide useful advice and counsel to those enlightened leaders who will certainly appear to espouse the virtues of smallness, of limited power of man over man, of decentralized authority, of the clean pure air of the countryside, which every man must seek and few men find.

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INVITED LECTURE

CHAIRMAN: GLEN R. PURNELL, CANADA DEPARTMENT OF AGRICULTURE

Some Problems of Agricultural Development*

ORIS V. WELLS

I MUST begin by saying something about the background against which this paper has been prepared.

I have for the last eight years been almost entirely engaged in administrative work. Indeed, this is my first Association meeting in nine years (after having attended, I believe, every annual meeting from 1928 into 1959). I serve most of the time as the day-to-day executive officer of the F.A.O. (Food and Agricultural Organization of the United Nations). We are a relatively small organization spending something more than $100 million annually and influencing to a considerable degree additional expenditures for foreign aid or international loan outlays of at least another $250 to $350 million. We are also quite a complex organization, financed from several main sources, employing some 2,200 professional officers assigned to operations or missions in some 100 developing countries in addition to our headquarters staff. We deal with agriculture, including fisheries and forests, and are necessarily as much interested in the problems of processing and trade as those of production. In addition, our assignment relates not only to rural welfare but to nutrition generally. All this keeps us in constant contact not only with the developing nations but equally with the other members of the UN family as well as most of the bilateral aid programs, the voluntary agencies, and the main foundations working in the developing world.

Quite obviously, my assignment is not conducive either to reading or producing much professional literature even though I do occasionally receive a draft paper from John Mellor or some of the other agricultural economists working in the field, and I do occasionally read an article in

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* I am indebted to a number of my colleagues in the FAO for advice or assistance in developing some of the ideas in this paper, especially Messrs. P. A. Oram and H. Quaix of the Indicative World Plan. The responsibility for the ideas expressed here, however, is mine and they do not necessarily represent the official policy of the FAO. I should also call attention to the fact that the presentation here is in considerable part based on my earlier paper on the same subject, which was presented at the opening session of the Society for International Development at its Milan meeting in June 1967.

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the Journal. But the most of what comes to me is what comes to other aid administrators, and a great deal of it comes through conversations, conferences, and arguments in our governing and coordinating bodies. I do not intend to document these conferences and legislative proceedings except to call attention to the proceedings (which I hope will soon be published) of the Rockefeller-Ford Foundation seminar with some leading aid administrators and UN officials, which was held at Villa Serbelloni, Bellagio, Italy, on April 23–25 of this year. In my judgment, this seminar (which I did not attend) left a strong impression on those who attended it. The Rockefeller group put forward a strong argument for a series of science-based, production oriented commodity improvement programs, centered around work originating from an expanding number of "centres of excellence" while the main Ford presentations, both by former presidents of this Association, F. F. Hill (1951) and Lowell Hardin (1964), dealt with the problems of social and economic priorities and difficulties, including the so-called "second" or "later-generation" problems that come with success.

So Mr. Chairman, Ladies and Gentlemen, what I have to say comes chiefly from my own observation, from watching the daily flow of problems and policy discussions among those administering or assisting aid programs in the developing countries. At the same time, I should warn you of the things that I am not going to discuss:

I am not going to discuss the importance of agriculture in the developing countries nor the necessity of agricultural development in most such countries as an essential to overall economic development. This I take for granted (but I have also presented the argument in detail in my paper at the Centennial Celebration for the USDA in 1962).

I am not going to discuss or argue about how much of the world's population is hungry or, more important, malnourished. There is, or so it seems to me, substantial evidence that the proportions are much too large. As well, there is substantial agreement, as was not the case a scant ten or twelve years ago, that the answer to all development problems in the predominantly rural developing countries is not immediately to be found through industrialization and general education or that it is likely or desirable that food surpluses of a few developed nations can or should guarantee the huge populations of the underfed world against hunger and malnutrition. These things I also take for granted.

Perhaps I should add that I am also not directly discussing Shaffer's basic paper (on institutional obsolescence and innovation) for this meeting, even though I feel I might well have used his title and many of his observations; nor am I discussing the Don Paarlberg thesis that our present rate of technological change (in the western world) exceeds the optimum rate. Both the main thrust of Shaffer's paper and the Paarlberg thesis seem to me to apply to the USA here and now. My concern rather is with the developing world where most of us believe an increased rate of technical change is essential.

Some Key Objectives of Agricultural Development

Before talking about the process of agricultural development, we may well ask what are, or perhaps more precisely, what should be the relevant objectives of the developing countries that may want to achieve a rapid expansion of agriculture in order "to provide a firm foundation" for the accelerated growth of their overall economies. I take these to be:

(1) Assuring the staple food supplies for a population typically growing at 2.5 to 3 percent per annum. For many countries this basically means achieving a faster rate of growth of cereal production. However, the pulses and the more economical sources of animal protein must also be included while, at the same time, wastes should be reduced.

(2) Changing the composition of the national diet to meet the specific requirements of a food policy which emerges from an analysis of the main dietary deficiencies, with appropriate attention to the effects of rising incomes and urbanization. Here the supply of protein is the most crucial problem.

(3) Earning and saving foreign exchange. Shortage of foreign exchange is one of the most serious constraints or "bottlenecks" to economic growth in most developing countries, and most of them depend mainly on agricultural exports as their chief source of foreign funds. Increasingly also, a great many of the developing countries are concerned with the economic possibilities of import substitution.

(4) Encouraging the institutional changes necessary to best move toward the above objectives. But in most developing countries such changes must be made in such a way as to provide a large part of the additional employment for an increasing rural population at least over the next fifteen years or so. This puts the emphasis on increasing productivity through intensification while at the same time helping to create opportunities for employment in the "agro-allied" industries (country based).

The Principles

Over the last 15 to 25 years a great deal of attention has been devoted to the problem of accelerating development in the developing countries. The USA has been actively engaged on a large scale bilateral program ever since President Truman launched the so-called Point IV Program; almost every other developed country has joined in, including the USSR. The UN system, through the specialized agencies and the UNDP, is increasingly involved; and a considerable number of the charitable agencies and philanthropic foundations are heavily engaged, to say nothing of the interest, the activities, and the leadership that now exist in the developing countries themselves. In view of all this, one might believe that there is a good understanding of the problems involved—that the way ahead is clear.

Actually, the problem, stated in terms of averages for the developing countries as a whole, may not seem too difficult to you. That is to say, population in the developing countries is growing at the rate of 2.5 to 3 percent per annum—a rate which is likely to continue for 15 years or more despite the increasing interest in population stabilization. Meanwhile, it appears to me that the most likely target for the average increase of G.N.P. for the developing countries for the UN Second Development Decade (DD2—1970-80) is in the process of being set at about 6 percent per annum. These facts, then, lead to a target of about 3.75 to 4 percent per annum for increased food or agricultural production, as compared with an actual annual rate of increase of about 2.75 to 3 percent over the last decade.

Surely, to many economists and development theorists, increasing an annual rate of growth by 1 percent, from 3 percent to about 4 percent, say, does not seem too difficult. But, in fact, the problem of increasing food production in the low income areas with rapidly increasing populations is an extremely difficult, intractable one. To begin with, we must realize that in such countries 50, 60, 70 or 80 percent of the population are in rural villages and often half or more of the nation's G.N.P. derives from agriculture. Foreign exchange and international aid or loan funds are scarce and, even given the best of management, the assistance that a country can give its population must always be quite thinly spread. New techniques and institutional arrangements must be introduced and usually this involves education: these take time. And in all too many cases, of course, the problem is further complicated by the fact that it must be solved in such a fashion that most of the current population, along with the natural increase, must remain in the agricultural sector.

All this does not mean that substantial progress has not been made nor that some general rules are not beginning to emerge. Some nations, as well as particular areas in other nations, have indeed done very well. Looking at these nations, as well as our own experience in FAO in working with many nations, has led me to suggest a provisional set of general principles toward which I think we should be moving—principles which I think are being more and more used in planning and appraising requests for assistance in the agricultural field. These are:

Principle one:

Small-scale, piecemeal technical assistance is simply not a sufficiently strong tool.

Stated so simply, perhaps many of you might agree; but the fact remains that small scale technical assistance, which can of course be a valuable part of any well planned, well executed program, is most appealing to many people for many reasons. It provides the material for good human interest stories; it is relatively cheap; it satisfies our desire to tell other people how to be more industrious; and, in many cases, it does pay off with a good substantial multiplier effect. Unfortunately, however, the adoption of one or only a few technical improvements in a few selected locations does not materially increase aggregate productivity or overall production as a whole. Conversely stated then, principle one leads to principle two.

Principle two:

It is increasingly evident that farming systems as a whole need to be substantially altered or redesigned in many areas, that what is needed is an integrated "package" rather than a "piecemeal" approach.

As one of my friends who loves to write about economic development said some time ago with respect to Mexico, where the development and introduction of improved seed stocks have made such an outstanding contribution, "Whatever the crop, plant breeding was just one step. The Mexican program gradually evolved into a balanced effort with geneticists breeding better plants, pathologists fighting disease, entomologists warring on insects, soil men rejuvenating the tired earth, specialists improving the livestock. For example, the higher yields required more plant food, and fertilizer was both scarce and expensive. This triggered growth of a new Mexican fertilizer industry." And since I want to return to the time factor later, perhaps I should say that the original work by the Rockefeller Foundation about which my friend writes started not two or three but 26 years ago—at the same time that the FAO Preparatory Committee was organized (1943).

The advantage of developing integrated "package" programs rather than trying to introduce piecemeal technical assistance was first brought to my attention by Dr. Salter of the old Bureau of Plant Industry in discussions that we had concerning American agriculture immediately following World War II. This idea is now making substantial headway in the developing countries. Further, it is apparent that something more than the technical knowledge of the better combinations of farming practices is necessary. To know which seed strains are best means little unless arrangements for producing and distributing such seed can be worked out. To know that one needs particular kinds and quantities of fertilizer for particular crops is not the same thing as having the fertilizers. And even if farmers know how to increase productivity, they are not likely to do so without knowing whether or how they will be rewarded for the extra costs and efforts involved. So this leads to principles three and four:

Principle three:

In addition to developing the necessary "package" of new practices or revised farming systems, ways and means must be found of supplying the necessary production requisites or capital inputs, many of which must come from the outside.

Principle four:

At the same time, ways and means must be found of motivating farmers to adopt the new practices or systems.

Principle three of course explains the current interest in assisting or working, wherever possible, with financing agencies, including, wherever practicable, private business, as well as the need for increasing supplies of production requisites—that is, fertilizer, pesticides, and farm machinery—moving through bilateral and multilateral aid to the developed world.

And it is principle four that takes us into a most difficult territory. How does one transfer technical knowledge to individual farmers who have a long ingrained acceptance and sophisticated knowledge of their traditional practices? How does one change not only practices but tenure arrangements in such a way as to effectively increase the incentives for improvement? How does one organize credit and marketing systems that will function at least reasonably well in the interest of the great mass of small scale farmers? How does one develop some reasonable, not too costly a system of ensuring minimum prices for farmers' products? Such questions as these lead into everything from cooperatives to agrarian reform, supervised credit and price support—all measures that require good central planning and usually strong continued governmental support (as also does the team or package approach to the technical or physical side of the problem).

Principle five:

Ways and means must be found of assisting or motivating the governments of the developing countries in giving the necessary priority to planning and actually carrying forward a sustained effort to increase agricultural productivity.

The reasons for this principle are obvious, given the scope and scale of the efforts that many of the developed nations must devote to food and agriculture. I mention it, however, in order to emphaize two points. The first of these is the need for assisting developing countries in their agricultural development planning, an activity which should have high priority. I also mention this problem of assisting or motivating governments because it means the aid-giving agencies must work with governments, must have personnel stationed at the actual seats of governments who work with the people mostly concerned with agriculture as well as with the other aid or assistance agencies working within the particular country; in short, the bulk of the work of increasing agricultural productivity falls on the farmers and governments of the developing nations, not on outside experts. Our experts are not, and should not be, plantation overseers or managers. Rather, their business is to help the country find the right answers, make the right plans, and develop within itself the competence to carry forward the necessary work.

Some Related Problems

So much for my suggestions as to the general principles against which one should make plans or appraise proposals in connection with rural and agricultural development activities in the developing countries. I now want to say a few words about food aid and family planning and then turn to what I call the "intractable" problems, that is, the constraints or conflicts that for the time being must be endured, since immediate solutions even in terms of theory are by no means clearly apparent.

So far I have been talking almost wholly about the problems of increasing indigenous food production of the developing countries. Some may interpret this as meaning that there is no need for continuing food aid to the developing countries over the next several years. Quite the contrary; despite the fact that there have been no massive crop failures in the last year or two and despite the so-called "miracle grains" which are now of great interest in the Far East, the fact remains that substantial amounts of food aid should continue to move to the developing countries for a number of years ahead. I think the governments of both the developed and developing countries recognize this, not only in view of the increasing volume of surpluses both in North America and Europe, but also the recent decision to extend the World Food Program on a continuing basis, the fact that the current $200,000,000 World Food Program pledging target will likely be oversubscribed, and the agreement of both the FAO Council and ECOSOC to advance the pledging target to $300,000,000 for the period 1970–71.

The problem as I see it is not whether food aid might continue, but how such aid might best be used. There are times and places, and such times and places have been much too frequent in recent years, where emergency food aid is essential. We do not want people to starve, but at the same time we want the rehabilitation process to move as fast as possible. We want to see that food aid, as far as possible, assists in the economic development of the recipient nations. At the same time we want to see food aid extended in such a way as not to discourage increases in indigenous food production.

I now come to the problem of family planning. Surely the population explosion makes this a priority problem. I recognize the social difficulties and the time factor involved, and I am certainly not suggesting that current technological prospects are not such as to offer a decade or more of time to work on this problem. But in my opinion recent developments only buy us time, and I agree that the problems of population growth will not disappear, that if we wait too long our options will be overtaken by events and that we should move as fast as possible. Family planning is not designed to destroy things, but rather to save them. It is not my purpose to argue this thesis at any length. Fortunately, it seems there is now a wide and increasing agreement as to the necessity for family planning and a fair chance that considerable progress may be made over the next two decades toward bringing the population explosion under some degree of control.

I now come to the intractable problems, that is, the problems that one simply lives with because there are no immediately satisfactory solutions. The first of these has to do with education. Certainly training and education are important parts of any development process, and there are a considerable number of people who argue that the basic solution to most development problems lies in creating educational and training institutions or arrangements, rather than immediately working on resource surveys, pre-investment analysis, and immediate action programs within the developing countries. Indeed, at the Bellaggio seminar, F. F. Hill indicated that if this were the year 1850 instead of 1969 he would feel that assistance to developing countries might be largely limited to educational activities, leaving it to each country to work out its own salvation in other fields; but this is 1969, and the population explosion forces priority to other problems, including food production. In fact, the developing countries themselves insist on action now and the problem is how to combine education and training into an overall development program.

Now, a second special problem: the staggering difficulties set by dense rural populations which continue to increase at a rapid rate. In those areas and regions where the hunger problem is most acute, ways and means must be found for increasing agricultural productivity, while at the same time maintaining on the land dense populations as well as a substantial portion of their natural increase over the years ahead. This also leads a considerable number of people to insist that the greatest single problem is the problem of rural employment. But creating jobs by simply spreading work is not a satisfactory solution, production must be increased. Ways and means must be found to increase agricultural productivity in order to make life in rural areas more economically rewarding and, indeed, in order to support the current or increasing populations at any reasonable standard. Also, it seems to me that ways of raising living standards so as to make life more attractive must be found over and beyond the problem of making farming itself more economically rewarding, and at the same time ways should be found to involve rural people themselves in decisions that affect themselves and their institutional framework. This problem of maintaining or increasing rural employment substantially conditions the technical solutions that may be suggested in many countries. I am not saying such solutions are impossible; in this connection, we are inclined to talk about the "Japanese pattern" in view of what the Japanese have been able to accomplish in terms of increasing agricultural productivity, while still maintaining a small farm technique and a relatively heavy farm population.

There is also a foreign trade problem, one I need not discuss at any length with agricultural economists. The source of foreign exchange for investment purposes in the developing countries is chiefly from exports of agricultural commodities from the developing countries themselves (with the exception of a few that happen to have oil or special mineral resources). But over a large portion of the developed world, agriculture is now so productive that the developed countries are large exporters of most temperate zone products, while at the same time synthetics and other substitutes are also cutting into many traditional markets. Most of the developing countries are seeking access to additional foreign markets and are hoping through commodity agreements or other trade arrangements for some increase in return per unit of farm products exported. At the same time, many of the developing countries are actively studying the problem of import substitution, of producing as much of their own needs as possible, in order to economize in the use of scarce foreign exchange, or in order that their foreign exchange may be used for investment purposes rather than to pay for imported food.

Finally, I come to the time factor, to which I have already referred several times. The adoption of new techniques, the revision of farming systems, and the motivation of farmers and governments, must often be accompanied by a substantial amount of training and education. Also, the finding or accumulation of the necessary financial resources can often involve a considerable amount of time; so most planners and most economic development theorists agree that a substantial amount of time is needed to plan and execute a successful development effort, but time, simple time, is a commodity of which most administrators and political leaders are lamentably short. And one of the driving forces behind the administrators and political leaders, of course, is the fact that time soon runs out for their hungry or poverty-stricken people. One of the most difficult problems in planning agricultural development activities is to find an acceptable mixture of short-term activities that accomplish what one can this year and the next, while at the same time understanding that any successful solution depends upon planning well now for efforts that must continue over a substantial number of years ahead.

ECONOMICS OF INPUTS

CHAIRMAN: JAMES NIELSON, WASHINGTON STATE UNIVERSITY

Structure of Input Supplying Industries and Techniques of Analysis*

DALE C. DAHL

THIS paper surveys the character of structural change in selected farm input industries, stresses the need for increased economic research in these factor markets, and presents some encountered and anticipated research problems and techniques of analysis.

G. Edward Schuh has provided a useful review of economic research since 1950 in the agricultural input markets [17]. His summary emphasized the relative lack of economic research and policy attention to these markets. Schuh's research review was organized around two concepts of structure: *market structure* research and *structural relation* research.[1] His annotation ranged the full spectrum of productive factors.

This paper is more limited in scope. It deals with U.S. feed, seed, petroleum, fertilizer, pesticide, and farm machinery markets.[2] Further, it tends to stress market structure research problems. This is because of particular inter-industry organizational developments during the 1960's. The substantial structural adjustments noted in these markets apparently have helped generate expanded research interest in the purchased input industries.[3] Recent emphasis in both market structure and structural relation research by the Economic Research Service and several state experiment stations suggest this increase.[4] Most recently, 14 states have joined a

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[*] The author is indebted to his colleagues at the University of Minnesota and to Paul Nelson of ERS, USDA.

[1] "For our purposes, let us refer to the econometric research which attempts to develop equations describing the behavior of economic entities as *structural relation* research. That research that has as its immediate aim the evaluation of the performance of a market or a description of its characteristic will be referred to as *market structure* research" [17].

[2] Other papers in this session of the meeting justify exclusion of labor and credit markets; the land market is avoided to emphasize purchased farm input industry interrelationships.

[3] Another leading reason, if not most important of all, is the decision to extend the use of Hatch funds under the "20 percen marketing" rule to the input markets.

[4] Within ERS, two research units have been most active: Farm Resource Branch, FPED, and Input Marketing Research Group, Pricing and Competition Branch, MED.

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Western Regional project entitled "Agricultural Factor Markets and Buyer-Seller Procurement Strategies" [8].

It is my contention that this expanded interest in factor market research is well justified. The patterns of organizational change, of market conduct, and of potential performance impact may be the most significant in the agricultural economy today. Let us review some of these changes.

Input Industry Structure

General patterns

The organizational changes in the industries that produce and/or distribute feed, seed, fertilizer, petroleum, pesticides, and farm machinery, while separately unique in many respects, also have a general uniform pattern. Each input-defined industry has decentralized its manufacturing (or formulating or mixing) phases in a geographic sense but has integrated manufacturing and distribution functions so as to yield larger local outlets than before. Further, each input increasingly is sold as part of a product-service package, increasing the extent of product differentiation of inputs and compounding difficulties in farmer purchasing decisions.

Another general characteristic of companies manufacturing farm supplies is increased diversification or conglomeration.[5] Of the input manufacturing industries reported in the *1963 Census of Manufacturers* (prepared animal feeds, agricultural chemicals, and farm machinery) the "specialization ratios" generally exhibited declined between 1947 and 1963, while "coverage ratios" increased over the same period [10].[6] This means that these input industry establishments classified by their primary product increased their production of secondary products over the time period. Thus, they became more diversified. It further suggests that increased industry concentration occurred during the same period.

The interaction of distribution systems among industries is clear but not as well documented. Two general distribution schemes are being tested and exist side-by-side in many input markets. Highly specialized outlets compete with highly diversified outlets. For example, fertilizer blending plants rival "farm service centers" that attempt to combine fertilizer distribution with a variable range of inputs, depending upon the farming area. A continuous search is made by input industry companies to find the "right" product-service package. It appears that more than one package type is demanded.

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[5] The terms "diversification" and "conglomeration" are synonymous to many authors. This is one such author.

[6] "Specialization ratio" is defined as the value of primary products shipped by an industry divided by the value of primary and secondary products shipped by that industry. The "coverage ratio" is the value of a primary product shipped by an industry divided by the value of a primary product shipped by all industries.

Two structural developments deserve more specific treatment: (1) the petroleum-agricultural chemicals industry interactions and (2) decentralization in the feed industry.[7]

Petroleum and agricultural chemicals

The following statement suggests the technical and economic connections between the petroleum and agricultural chemical industries:

> . . . the interest of the petroleum industry in agriculture extends far beyond supplying farmers with fuel. The industry also owns the basic sources of natural gas, a major raw material in producing ammonia for fertilizer, and accounts for nearly 40 percent of the synthetic anhydrous ammonia production capacity. Furthermore, a number of petroleum firms have diversified into fertilizer mining and manufacturing operations in recent years. Petroleum hydrocarbons are also the base for many of the present-day agricultural pesticides, and for urea, an important nitrogen product used for fertilizer and feed [2].

During the later part of the 1950's and to the present time, a competitive "battle of giants" was recorded in U.S. agricultural chemical markets. Major petro-chemical companies entered into the production of synthetic anhydrous ammonia, only to be faced with a lack of retail outlets for their product. It became clear that either the more volume-oriented distribution systems of the cooperatives would be required to handle the increased quantities of fertilizer or a new distribution system must be developed [1]. The latter strategy was followed when bulk blending of dry materials became technically feasible in the early 1950's [4].

This move to by-pass the traditional distribution system for fertilizer was countered by the cooperatives. They responded by building their own dry blending facilities and integrating backward into the primary production of anhydrous ammonia. These competitive strategies netted the cooperatives a 14 percent share of U.S. anhydrous ammonia production and a 30 percent share of all fertilizer sales in 1966 [13].

These technological and competitive developments reduced manufacturing and distribution costs, lowered the price of fertilizer dramatically, and encouraged substantial increases in farm uses of plant nutrients. Whether the crop response netted an income gain to farmers is debatable; the adjustments in the fertilizer industry left excess capacity at localized geographic points [9].

Cooperatives have continued to respond to competitive pressures from private firms in pesticides. Cooperatives have integrated backward into pesticide formulation. They now account for 15 percent of total sales [12].

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[7] I tend to agree with George R. Allen that these are the most significant developments in the purchased farm input markets in terms of their impact upon farmers and the input manufacturing and distribution system [6].

Decentralization in feed

Substantial increases in the consumption of commercial feed have been recorded in recent years. It was estimated that 60 percent of the four principle feed grains moved through commercial channels in the 1960's [3].

Patterns of competitive conduct have been characterized by the "contract movement" in the 1950's and the location of satellite manufacturing facilities in areas of heavy feed consumption in the 1960's [15]. In 1947 there were 2,688 prepared animal feed establishments in the United States; these dropped to 2,292 by 1954 as contractual efforts by larger firms urged the exit of many smaller mills. The trend to satellite plants is evidenced by an increase in establishments from 1954 to 1963 (to 2,590) [10].

Cooperatives have played a significant role in feed manufacturing, accounting for between 20 and 25 percent of sales in recent years. Cooperatives have supported extensive product differentiation by offering their own brands and special services. If taken as evidence of firm rivalry, this agrees with Padberg's judgment of good industry performance [16].

Retail market structure

The adjustments occurring in agricultural chemical and feed markets show trends of combining manufacturing or mixing activities with retailing and wholesaling functions at localized geographic points. This development, as indicated previously, is coupled with either forward integration to the retail level or backward to the level of primary producer or manufacturer. While these examples serve to illustrate a higher degree of input specialization in a product sense, the trends are contrary to more recent developments in farm service center activities. Like many terms, "the farm service center" has come to have various meanings to different people. One definition is "a grouping of two or more product or service activities at a retail level for the purpose of merchandizing farm inputs." Such a definition has little operational value in research. Most companies who deal in a singular product offer sufficient numbers of services to claim they are a farm service center. As we individually conjure up our own stereotype of a farm service center, we may think of some "complete" complex of shopping center type activities for farm production inputs under singular ownership. Of course, the particular combination of enterprises that go into a farm service center depends upon the type of farming activity present and judgments regarding economies of distribution and processing and sales potential around the center itself.[8]

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[8] As discussed by Ronald Aines at the NCR-20 Seminar on "The Economics of Conglomerate Growth," Kansas City, April 30, 1969.

A recently advertised concept of the farm service center is exemplified by National Farm Stores of Minneapolis. This organization, financed by Litton Industries, manages a farm family consumption mart and hardware store. It builds, owns, and leases buildings to house petroleum, fertilizer, feed, seed, machinery, and other agricultural services and products to other companies.[9] Such an arrangement has obvious advantages over a single-owned complete farm shopping center. It minimizes the amount of investment needed, takes advantage of specialized managerial talent already existing in the several industries, and spreads the risk of enterprise failure.[10]

Some input market researchers have questioned whether the farm service center is likely to be a major farm input retail outlet in the future. The hypothesis is that most farm service centers are frequented by smaller farmers. The larger farmers purchase their inputs in large quantities from wholesalers or directly from the manufacturer. If this hypothesis is true, purchasing patterns existing with larger operators now may well be purchasing patterns that will exist for a very large segment of agriculture in future years. A counter hypothesis merely points out that the multi-product, multi-service cooperative is now a form of service center that already discriminates among buyers; it sells large quantities of inputs to larger farmers at lower costs.

Market conduct

A study recently completed at the University of Minnesota described the character of firm strategies involved in dealing competitively at the manufacturing or primary producer level of input marketing activity within an industry and between industries [14]. This study also characterized and rationalized economic behavior in negotiative or across-the-market relationships between the manufacturers and the wholesaler/retailer customer with whom they dealt. An attempt was made to relate observed behavior patterns to the market or industry structure that existed. This reverse order procedure of attempting to describe patterns of market conduct and then ascribe these to structural conditions in the market, resulted in comparable relationships that might otherwise have just as easily been found by looking at structure first and conduct second.

One aspect of market conduct in the input industries of particular note is the systems orientation (rather than product orientation) as an operational element. As pointed out by Ken Farrell [11], the Food and Fiber

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[9] As discussed with Darrow R. Beaton, General Sales Manager, National Farm Stores, Inc., Minneapolis, Minnesota.

[10] Another definition of a farm service center was presented to me some time ago by a small town businessman who said, "A farm service center? Say, that's what my home town is, isn't it?"

Commission provided evidence of a systems orientation in the input markets and trend toward broadened product and service portfolios. In the case of manufacturing, according to Farrell, the petroleum-rubber complex devotes 20 percent of its total assets to the production of agricultural business services and products; motor vehicles and parts, 15 percent; and the chemical industry, 10 percent.

This type of thinking also seemed to prevail in the study of 57 major farm input manufacturers who ultimately sell their products to Minnesota farmers [14]. It was further clear from this study that maximization of sales volume and increases in share again show up as a major motivational force. This, of course, is consistent with more recent theories regarding technostructure and corporate incentives for growth and power.

Input Industry Analysis

Research needs

The need for economic research and policy orientation in input industries is quite general. Various people have made suggestions for research studies; most notable among them, Willard F. Williams [20], who proposed a broad-based approach to the study of the characteristics of farmer demand for agricultural inputs. On the basis of a survey of agricultural supply industries, Williams found that most industries are having considerable difficulty in determining farmer consumer demand characteristics. Within this context, Williams also stressed the need for more adequate market information for the farmer-buyer. Other studies have demonstrated a serious lack of knowledge on the part of farmers purchasing many types of agricultural inputs [5].

Another significant area of research encouraged by Williams is farmer demand for services. Perhaps one of the more recent studies in farmer demand for services was done at Harvard University, dealing with farmer use of computer services [19].

Additional research recommended by Williams includes studies of the distribution patterns and practices in the different farm input markets, cost, margins and price index studies, and the study of economic relationships in a systems approach.

Additional recommendations have been made by Paul Nelson, and others are being initiated by members of the Production Resources Branch of the Farm Production Economics Division of ERS.[11] Some of these recommendations include development of situation reports for each agricultural input, development of an "input bill" similar to the marketing bill now used on the product side, and studies of various grading systems that might be employed to permit farmers to judge the quality of inputs purchased. A more complete market news system to identify input prices at different point locations in an area also has been suggested.

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[11] As discussed with Paul E. Nelson, Velmer Davis, Ronald Mighell, and David Harrington, ERS-USDA.

Technique of analysis

Willard Williams properly points out some of the inadequacies of using market structure research in a traditional sense [16]. First, this technique of analysis as generally employed is not inherently problem oriented. It is not generally directed toward well-defined, carefully stated problems with specific goals. Secondly, this technique of analysis, while public policy oriented, does not provide the kind of answers useful in public policy administration. While both of these charges are correct, I am sure that Williams would agree that market structure analysis, depending upon the researcher, *can* be problem oriented and could be policy administration oriented as well.

While I believe a certain amount of research to acquaint one's self with the industry may be justified, piece-meal descriptive studies attempting to describe a dynamic industry at different points in time will yield few satisfactory results.

The nonadditivity of marketing research results in previous product market research was clearly suggested by Jim Shaffer [18]. This shortcoming could easily repeat itself in input marketing research as well. Therefore, I embrace some of Shaffer's thoughts. He states that certain aspects of research in any area should not only be problem oriented and policy directed, but also should be thought of as being carried on by teams, consortiums or task forces. One technique that could be used to encourage task force type results and still retain a high degree of individuality would be to require that each research project headed by an individual or a government agency have assistant project leaders from related and outside agency groups interested in the problem. At the experiment station level this could be made operational, for example, by requiring that no research project be approved unless three assistant project leaders are named along with the person submitting the project for approval. The assistant leaders would also be held accountable for the results of the project.

Clodius and Mueller [7] list some of the significant problems in dealing with market structure research. These problems include disclosures of information given in confidence and unwillingness of firms to indicate that they have in fact been guilty of antitrust violations. One technique used in a Minnesota study was to obtain information about firms by asking questions of their competitors [14]. Firm A may well be willing to talk about the competitive practices of firms B, C, and D. A reasonably good picture of market conduct may result if firm B agrees with A as to the conduct it attributed to firms C and D.

The emphasis on market structure research method here should not imply a preference of technique. Its stress is founded upon previous discoveries of a general lack of perfection in the agricultural input markets. Where analysis permits, other established research techniques should be used.

Conclusions

This paper has demonstrated that only recently has there been an increase in economic and market structure research activity as it relates to certain purchased farm input industries. The recent flurry is due to a change in funding availability and organizational changes, resulting in altered market conduct and performance in these input supplying industries. Of particular note are the adjustments that have occurred in the agricultural chemical markets and in feed manfacturing. A broad list of research activities is needed, ranging from demand studies for inputs and services to systems analysis to market structure research. I hope that from our experience in the product market that we can conduct input market and industry research to provide "needed" answers and additive results about important economic relationships on the farm supply component of the agricultural economy.

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Concepts of Finance Capital for a Capital-Using Agriculture

C. B. BAKER AND JOHN A. HOPKIN

IN 1959, 1.2 million farms in the North Central Region, using $21.6 billion in non-land capital and $62.7 billion in land and buildings, produced $10.0 billion of output [5]. Had farms been organized in the region to produce at a minimum cost, 741,000 farms could have doubled this output with the same investment in land and buildings and with $28.6 billion in capital. The results would have been disastrous. The market failed to clear all of the *actual* 1959 output. Had the output been constrained to a "market-clearing" level, 306,000 cost-minimizing farms in the region would have used $12.2 billion of capital and produced $9.1 billion of output.

This summary of results is instructive in that it indicates the puzzle one confronts in projecting capital use in agriculture. Changes in technology have clearly increased the capital required per successful farm. But to project increases in total capital on the basis of technological change alone seriously overestimates total capital requirements. In fact, estimates of 1980 capital requirements that take market clearing into account show a *reduction* in non-land capital of about 46 percent, relative to 1959. The value of land and buildings declines by about 3 percent. But *per farm*, non-land capital increases by 96 percent; land and buildings, by 253 percent.

Our central concern is with the financing of the individual farm firm. Capital management affects the rate of firm growth, through leverage, and the vulnerability of the firm, through liquidity. Capital accumulation constitutes a major form in which farm earnings occur and a major drain upon farm liquidity. A farmer may earn at a satisfactory rate, accumulate an equity in assets, and yet suffer from a low level of disposable income. On the other hand, to divert income from capital accumulation to consumption purposes may so retard a farmer's growth rate as to jeopardize his ability to survive in the dynamics of a capital-using agriculture. Such is the puzzle that faces the farmer in today's agriculture.

Our purpose is to explore the effects of leverage and liquidity on the growth characteristics of the farm firm, the influence of credit on equilibrium of the firm, and the implications of such an equilibrium for resource allocation, firm growth, and achieved levels of income and net

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worth accumulation. We will conclude with a resumé of policy issues generated by structural changes in agriculture that in turn are the result of management response to economies available in finance capital.

Levered Growth

It is common to measure growth of the firm either by increments in rate of income flows or in equity of the firm. The normative ideal would be a composite that reflects the increment to utility of the firm operator. Equity seems to be a reasonable welfare proxy for the operator who owns assets of the firm, either totally or subject to debt. It may not be for the operator who leases a substantial fraction of the firm's assets. For the latter, equity may be more plausible if it includes, as we do, non-farm assets as well as farm assets. Having selected equity as the growth measure, it seems more convenient to define leverage, L, as the ratio of debt, D, to equity, E, where E is the difference between the value of assets, A, and D [12].

Let the annual increment in equity be given by

$$(1)\ g = (rA - iD)\,(1 - t)\,(1 - c)$$

where r = rate earned on assets in the firm, net except for interest and taxes,

i = rate paid on debt,
t = rate paid in taxes on returns, and
c = rate spent on consumption out of firm earnings.

It is convenient to express growth g' as the annual percentage change in equity, given by

$$(2)\ g' = [L(r - i) + r]K,^{1}$$

where $L = D/E$, the chosen measure of leverage, and

$K = (1 - t)\,(1 - c)$, the percent of earnings remaining after consumption and taxes.

Thus g' is determined by r and L, given the rates of consumption, taxation, and interest. We shall later modify i. We now explore briefly some of the implications of (2) in its present form.

In Table 1 we show g' for several values of r and L. The values likely include many real-life conditions in a farm firm. The first column of Table 1 confirms that the growth rate of a firm is unaffected by leverage

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[1] (2) is derived from $g' = \frac{\Delta E}{E} = \frac{rA - iD}{E}K = \frac{r(D + E) - iD}{E}K$
$= \frac{D(r - i) + rE}{E} = [L(r - i) + r]K.$

when the interest rate equals the net earnings rate on assets. The growth rates in this column are less than the earnings rate of 7 percent by an amount equal to consumption and taxes.

The first row shows the growth rates for a debt-free operator at each of the earnings rates indicated in the column headings. At $L = 0$, the growth rates are wholly determined by the earnings rate, given the consumption-tax factor. g' is less than r because of the dampening influence of consumption and tax payments. A reduction in either would raise the growth rate. An increase would reduce it.

Table 1. Growth rates (annual percentages) implied by alternative leverage, *L*, and rates of earnings, *r*: consumption, tax, and interest rates specified at .4, .25 and .07, respectively

L \ r	.07	.10	.12	.14	.16	.18	.20	$g' = r(KL+K) - KLi$
0	3.15	4.50	5.40	6.30	7.20	8.10	9.00	$= .45r$
.5	3.15	5.18	6.53	7.88	9.23	10.58	11.93	$= .675r - .01575$
1	3.15	5.85	7.65	9.45	11.25	13.05	14.85	↓ $= .9r - .0315$
1.5	3.15	6.53	8.78	11.03	13.28	15.53	17.78	etc. $= 1.125r - .04725$
2	3.15	7.20	9.90	12.60	15.30	18.00	20.70	$= 1.35r - .0630$
2.5	3.15	7.88	11.03	14.18	17.33	20.48	23.63	$= 1.575r - .07875$
3	3.15	8.55	12.15	15.75	19.35	22.95	26.55	$= 1.8r - .0945$

A conservative borrower might limit his debt to half the value of his equity ($L = .5$). Results in terms of growth rates can be read from the second row of Table 1, for specified rates of net earnings. Even this small leverage can be seen to influence growth rates, especially at higher values of r.

Conventional lenders are likely to limit the borrower to a debt level about equal to his equity. That is, $L = 1$ may be a rough approximation of limits faced by a farm operator who restricts his use of credit to conventional lenders and debt instruments. The third row reveals a gain in growth rates that is perceptible at all rates of earnings.

The operator willing to use a land purchase contract may attain a value of $L = 2.5$ if non-real estate lenders do not discriminate against him in financing his other assets. The lending limit for non-real estate borrowing is assumed at about a dollar of debt per dollar of equity. The growth rate at this value for L exceeds net earnings rate, r, when the latter reaches levels of 14 percent or more.

Why not strive for still higher leverage values? The answer is fairly obvious, especially for the proprietor firm. The operator likely will have exhausted his credit on conventional terms at between 1.0 and 2.0 and almost certainly at 2.5. More borrowed funds would entail use of higher cost lenders who are willing to assume higher risks in return for higher interest rates. It can no longer be assumed that i is a constant with respect to L.

Other limitations also are readily apparent. As incomes increase it is likely that the tax rate, t, will increase. On the other hand, the rate of consumption expenditures may well decrease. Hence a constant value may reasonably approximate the combined effects of c and t.

Our model represents a firm with constant scale at alternative combinations of debt and equity. Empiric evidence suggests that constant returns may be a good approximation over wide ranges of production conditions. But it probably is not safe to assume r constant for some larger sizes implied by higher values of L.

A more serious limitation is found in a subtle point relevant for research in financial problems. The concept of leverage does not include costs other than interest. But to exchange credit for loans (that is, to increase L) entails a loss of liquidity. Held in reserve, unused credit provides liquidity with which to meet the effects of an unfavorable event in production or marketing. Hence we need, finally, to develop a concept of liquidity as an essential element in financial management.

Credit-Liquidity and Equilibrium

Liquidity is an attribute of the financial organization of the firm [3]. We conceive the value of a firm to be the amount that could be obtained from sale of the firm as a complete aggregate. The sale of asset(s) within the firm will in general reduce the value remaining in the firm by as much as or more than receipts from the separately sold asset(s). If the cash acquired from separate sale equals exactly the loss in firm value, one concludes that the asset(s) is(are) perfectly liquid.[2] For those assets whose sale would contribute less to cash than to a reduction of remaining firm value, the asset(s) is(are) less than perfectly liquid. So conceived, assets can be arrayed in terms of their contribution to the liquidity of the firm.

Many assets of the firm are not incorporated into the firm's asset structure in expectation of separate sale. Yet they can be used as a partial basis for credit through exchange of a part of the bundle of property rights for a loan. This is the part to which we have assigned the concept of credit. Credit may depend on more than the collateral value of the firm's assets, but it is reasonable to assume that assets contribute to liquidity in the form of "credit" as well as in the form of potential sale. Indeed for many assets, the credit form of liquidity is more available and more likely to be used than is the sale form of liquidity.

Just as the concept of leverage lacks an explicit cost associated with use, liquidity lacks an explicit return associated with its use. Indeed, the two concepts are most useful in an equilibrium frame of reference. Leverage operates as a multiplier with respect to the marginal value product of resources added to the firm. If the marginal value product is positive, no explicit limit terminates the addition of financed assets. But if liquidity is valuable to the firm, increasing debt relative to equity reduces credit left to finance capital assets or operating expenses in the future, or to meet unforeseen financial problems. It is reasonable to argue that as credit is reduced, remaining units of credit acquire successively higher values. That is, credit is used at a cost that increases as debt increases, even though the rate of interest may remain constant over wide ranges of credit use.[3] Liquidity and leverage are concepts of central importance in the financial management of the farm and credit is an important component of a firm's liquidity.[4]

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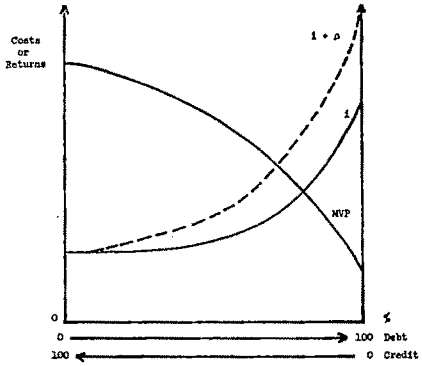
[2] The time required for sale may influence the price expected for either the separate asset(s) or for the farm as a whole. To incorporate this property of the exchange implies that we assume time that is comparable as between the two cases.

An equilibrium in credit-use is depicted in Figure 1. Increments to costs or returns from credit use are shown on the vertical axis, units of credit or debt on the horizontal axis. The curve labeled MVP describes increments to returns from resources financed with loans. The curve labeled *i* describes increments to loan costs from added units of debt. Its slope reflects the presumption that the farmer faces higher-cost loan sources as his debt increases. The quantity, ρ, is the value ascribed by the farmer to a unit of credit held in reserve. Its slope reflects the presumption that the value of credit increases as successive units of credit are absorbed by loans.

Figure 1. Firm equilibrium in the use of credit



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[3] Interest rates too may increase as the borrower exhausts first low cost sources and then higher and higher cost sources. The point is that the opportunity cost *to the borrower* increases, whatever the behavior of lenders available to him, through their behavior is certain to affect the objective value he places on unused credit.

[4] The effects of credit management on optima in the firm are explored in theoretical terms in [1] and [2].

Finance and Within Firm Resources Allocation

The effects of credit-use on production equilibria of the farm firm have already been outlined [1]. In summary an optimum combination in resource use is achieved when

$$-\frac{dX_2}{dX_1} = \frac{p_1 + f_1}{p_2 + f_2}$$

where p_i is the price of input X_i, and

f_i is the marginal cost of financing a unit of X_i, including the cost of liquidity lost in the transaction.

There is little empiric reason to suppose that $f_1/f_2 = p_1/p_2$. Hence the incorporation of credit-use, *whether or not* actual borrowing occurs will influence resource combinations. Similarly, where lenders favor one enterprise (product) relative to another, the optimizing product combination is altered. The resulting optima are determined not only by product price ratios but also by farmer expectations on lender behavior with respect to alternative enterprises.

In a behavioral context one must modify the hypotheses commonly used so as to include aspects of credit and finance capital. It is plausible to suppose that a growth-conscious farmer is aware of the value of reserved credit as well as of leverage in growth. He will be concerned with growth in credit, as in other resources, allocating credit to high payoff usages, especially as successive quantities of credit are withdrawn in borrowing. Indeed, with the increasing sophistication generally predicted for tomorrow's commercial farmers, these concerns will likely increase relative to other problems and become more and more explicit in the farmer's allocative calculus. Hence financial components will become increasingly relevant in models used in prescriptive and behavioral research as well as in education and counselling with farmers.

A farmer's credit is differentiated in terms of loan source as well as by farm characteristics. Hence credit management relates to source as well as use of credit. Farmers appear to be shifting from specialized suppliers of finance capital to input merchandisers to finance important aspects of their organizations. Is this to be explained by convenience? Or is it to be explained by greater credit tolerance of the input suppliers because of their stake in merchandising? Or does the farmer conserve his "general purpose credit," available from the supplier of the finance capital, because of its liquidity value? All these explanations are plausible, though clearly some may be more useful than others as behavioral explanations of the farmer in the act of financing.

Interfirm Complementarities Relating to Finance

Much of the new technology in production creates possibilities for economic gain from specialization, making production more intensive in terms of both capital assets and finance capital. In response, markets develop outside the farm firm for many products and services previously identified as part of the farming operation. The industry is thus segmented into many economic stages.[5] By definition, each firm has at least one economic stage.

Changes in marketing, on the other hand, have increased the payoff from closer coordination of successive production stages to increase the precision with which the final products meet market specifications. Market-oriented firms allocate in response to prices and other terms of exchange generated in part *external* to the firms. But when there are important complementarities or supplementarities between successive stages or where the price mechanism is not functioning efficiently, there may be gain through *internal* coordination of successive stages.

These changes require that a broader focus for finance research, to include problems of financing an interrelated set of production stages, whether market-collected or internalized within firms. Indeed, finance plays an important role in interstage and interfirm coordination. Depending upon the circumstances and point of view, it can be either the means for accomplishing coordination or an important by-product of the process. For example, before a vegetable producer can finance his operation, he usually must secure a marketing contract and establish his capacity to produce to the quality, quantity, price and other significant specifications of that contract.

Where important interstage complementarities exist, coordinating such stages within a single firm through vertical integration tends to increase the financing available to the total enterprise. Not only do small firms often find that through integration they have access to a greater volume of credit from new sources, frequently the total volume of financing available to the integrated industry is greater than was the total financing to all the segments prior to integration.

Structural Consequences for Agriculture

The changing role of finance is generating important structural changes in agriculture, some of which are implicit in our discussion of interstage coordination. We will briefly discuss two among many additional consequences.

If the traditional owner-operator pattern is to continue to dominate agriculture, *growth* and *economic viability* will need to replace a *deft-free balance sheet* in the hierarchy of goals of farm operators [10]. Even so, the separation of ownership and management appears to be an inevitable structureal condition of a capital-using agriculture and is proceeding at two different focal points.

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[5] Following Mighell and Jones [13], we define an economic stage as an operating process that starts with marketable inputs and ends with salable products.

First, with *financial* assets: Money capital is supplied by stockholders in exchange for shares of the undifferentiated assets and residual profits of the business, while management and labor is provided professionally in exchange for salaries and wages (including retirement programs and other fringe employee benefits) [11]. The large corporation provides both the intellectual and mechanical framework for tapping the money market for equity capital and is then in a stronger position to secure more liberal nonequity financing than is the typical farmer.

Second, with *non-financial* assets: Individuals or corporations might make particular physical resources available to the farm business in exchange for money claims against the business. There is no reason why the firm owning farm resources and the farm production firm need be the same or even have the same legal or structural form. Leasing, custom hiring of services, or the financing of inputs by suppliers and marketing firms are alternatives to incorporation as a means of providing control over outside capital to farmers. Efforts toward improving these markets might reduce some of the attractions which currently seem inviting to corporations.

Such structural implications suggest significant changes in the market behavior of agricultural producers. Will they become more or less responsive to price in the supply of farm products and demand for farm inputs? The answer will depend not only on changes in interstage coordination, but in the manner in which financial aspects are incorporated with those of production and marketing in firm equilibria. In turn, this depends upon expectations held by producers on behavior of lenders and lessors accessible to them, and upon the internal business structure of the firm.

Policy Issues in Finance

The expanding role of capital in agricultural production and marketing increases the impact of both private and public financing decisions on such important policy issues as (1) resource control and the organizational structure of agriculture; (2) resource efficiency; and (3) farm prices, income distribution and poverty in agriculture [6]. Whether the growth through financial aggressiveness generates diseconomies in a welfare sense must be the subject of another paper

Resource control and organizational structure

If our earlier discussion of the "structural consequences" is relevant and not too wide of the mark, relative skills in financial management and attitudes toward the use of debt are crucial in determining firm growth. In the long run, the factors affecting firm growth will largely determine the organizational structure of agriculture. It is an exceptional farmer who can match the corporation in terms of financial management competence. Responsive financial intermediaries can help. But they have limited capacity relative to the magnitude of the task.

If a national policy objective is to maintain family farming in a dominant role, resources allocated to research and education in financial management likely will have a favorable payoff. In fact, it might be *the one* important area where the fruits of research and education might not work to the relative advantage of large corporations

Resource efficiency

We have already shown that the optimum combinations of resources and products when differences in financing costs are included will differ from optima based on the price ratios. We suggest that the relevant optimum, in terms of social optimizing, will include all differences in the real cost of financing, including risk. Deviations from this optimum can be caused by (1) lender attitudes based on a lack of knowledge or personal preference which leads to responses not supported by differences in the real cost of financing, and (2) erroneous farmer expectations of lender response. Such simple matters as helping lenders understand the nature and details of the farm businesses in the community and helping farmers sense and understand lenders' attitudes might well shift resource use toward greater efficiency.

The heavy reliance on liberal financing to promote sales of some farm inputs might lead to a misallocation of resources. Farmers might subsitute a more costly input for a cheaper (but equally effective) one solely because the terms of financing are much more favorable. As a consequence, farmers may be able to obtain more (and possibly cheaper) financing for these inputs than for lower priced substitute inputs.

Programs that reduce income uncertainty from particular products (whether initiated by public groups, such as the price support program, or by private groups, such as a futures market in fed cattle) tend to increase the financing available for these products relative to others. Recent shifts in the fresh vegetable industry toward broad geographic diversification to spread weather and price risks are generating favorable lender response.

Farm prices, income distribution, and poverty

Increased stress on finance to achieve efficiency goals likely would speed up trends toward larger scale agriculture and the elimination of small scale family farm enterprises. Yet it cannot be taken as certain that size always is positively associated with socially relevant efficiency [7]. In any event, conflicts between goals of efficiency and such other expressed goals as rural stability and an egalitarian distribution of farm income must be resolved largely outside economics.

Poverty in agriculture arises from too few resources and/or inefficiency in the use of available resources. Farm credit programs can help resolve farm poverty problems only when they can materially help correct one or both problems. From his study of the Farmers Home Administration, Herr [9] concluded that for the 825,000 older farmers with chronically low incomes, production and investment credit would be of little value. But for those younger farmers with management potential, liberal supervised credit might have a significant payoff to general welfare. Credit generally is a very costly way to make permanent income transfers.

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National Labor Relations Legislation: Possible Impact on American Agriculture

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FARM workers and their employers are specifically excluded from the privileges and duties of the National Labor Relations Act (NLRA). This excludes farm workers from the right to organize and bargain collectively and their employers from protection against illegal strikes and secondary boycotts [8]. Several bills are now (August 1969) pending in Congress that would modify the present exclusions. Observers of farm labor legislation intimate that significant legislative changes are not likely in this congressional session. However, it is generally acknowledged that most of the major provisions of NLRA will be extended to hired agricultural workers within the next year or two. Final legislative form will depend largely on the relative influence and strengths of the opposing parties on the central issues of strikes at harvest time, union recognition, secondary boycotts, voter eligibility, and compulsory bargaining.

That agriculture has not been covered by NLRA does not necessarily mean that the agricultural sector has been unaffected by NLRA coverage of other sectors through its effect on off-farm job opportunities of agricultural workers. Space precludes an examination of such secondary effects, as well as an examination of the nature and functioning of the hired farm labor market. However, these two topics have been discussed elsewhere [1, 6, 9, 10, 15].

This paper focuses on the probable incidence of the costs and benefits within the agricultural sector of extending NLRA coverage to farm workers and their employers. The costs and benefits of NLRA will not necessarily be equally distributed geographically, sectorally, functionally, or personally. Furthermore, the initial recipients of the costs and benefits may lose or "relinquish" [11, p. 88] them to others as time passes. This is not to say, however, that NLRA legislation is necessarily a zero-sum game where the opponents vie for a bigger slice of a fixed static pie. Indeed, the second section of this paper concentrates on the more dynamic positive sum gains of NLRA.

Influence of Unionism on Wages

Influence of unionism in non-agriculture

Lewis [5, p. 543] concludes, after reviewing empirical findings based on 21 recent studies of unionism and wage differentials in the United

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States, that the ". . . effects of unionism on the relative wages of union workers tended to be greatest during periods of rapid deflation of the general price level and lowest during times of unexpectedly rapid inflation. . . ." This variability of effects of unionization over time is usually attributed to wage rigidity. The influence of unionism on wages tends to be accounted for more by the negative correlation of wages with the rate of inflation than by positive correlation of wages with unemployment rates.

The industries in which unionism had the greatest effects on relative wage rates tended to be those with high relative wages and with a high proportion of union workers. Lewis estimates the effect of unionism on the average wage of all union workers, relative to the average wage of all non-union workers as:

1932 (rapid downturn of depression)	25 percent
1939 (depression recovery and pre-World War II)	10–20 percent
1945–48 (war period rapid inflation)	0 percent
1957–58 (recessionary period, low inflation)	10–15 percent

Lewis's summary estimates are not ideally suited for examining the possible impact of unionism in agriculture, as they are based on aggregate data and pertain to non-agricultural industries. Thus, we must be cautious in drawing implications from them for unionism in agriculture. Since agriculture is not a high wage industry and since the unionized proportion of agricultural workers is apt to be low, I anticipate that unionism of farm workers would result in lower relative wage effects than it has had in the industries which Lewis reviewed. This, of course, is not to say that wages of hired farm workers, whether unionized or not, will not increase substantially in the future. Indeed, even though there has been no significant unionism, since 1965 average hourly earnings in agriculture increased slightly relative to manufacturing [15]. Still, average hourly earnings in agriculture are presently less than half those in manufacturing.

Derived demand for hired farm labor

The (static) factors that contribute to the variations in the effects of unionism on wages in the short and intermediate time periods (roughly 1 to 10 years) can be identified and analyzed by the derived demand theory for labor. Assuming that (a) the production function for aggregate agricultural output is linear and homogeneous, and (b) that the two factors of production—labor and non-labor (hereafter "capital")—are used so that their marginal value products equal their prices,[1] the elasticity of derived demand for labor in equilibrium is [3, pp. 241–6]:

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[1] The restrictiveness of these assumptions is tempered somewhat by the fact that the results are being used for short-run analysis. The limitations and omissions for long-run analysis are discussed in the next section. Nevertheless, even in the short

$$\lambda = \frac{da}{dp_a}\,\frac{Pa}{a} = \frac{\sigma(n + e) + ke\,(n - \sigma)}{(n + e) - k\,(n - \sigma)} \tag{1}$$

where σ = elasticity of substitution between capital and labor; n = price elasticity of demand for agricultural output; e = elasticity of supply of capital; k = share of output receipts going to labor; Pa = wage rate; and a = labor input.

Derived demand theory (equation 1) indicates that the elasticity of employment with respect to the wage rate (λ) depends upon the elasticity of substitution of capital for labor (σ), the elasticity of demand for agricultural output (n), the elasticity of supply of capital (e), and the relative share of labor (k). More precisely, in equilibrium the percentage decrease in labor employed corresponding to a one percent increase in the wage rate will be lower; i.e., the derived demand for labor will be more inelastic [3, p. 242]: (1) the less readily capital substitutes for labor; (2) the smaller the share of labor costs (provided $-n<\sigma$);[2] (3) the less elastic the supply of capital; and (4) the less elastic is the demand for agricultural output.

The rough calculations of λ in Table 1 suggest an elasticity of about -0.2 in the short run of 1 to 2 years and about -1 to -2 for a period of 5 to 10 years.[3] This means that if unionism results in wage increases of (say) 10 percent, employment of hired farm labor would be expected

Table 1. Elasticity of derived demand for labor (λ) for alternative demand elasticities (n), labor share (k), and elasticity of substitution (σ)[a]

Labor share (k)	Demand elasticity (n)	Elasticity of substitution (σ)		
		$\sigma=0$	$\sigma=1$	$\sigma=2$
$k=0.1$	$-n=0.25$	− .02	−0.9	−1.8
	$-n=1.00$	−0.10	−1.0	−1.9
$k=0.3$	$-n=0.25$	−0.07	−0.6	−1.0
	$-n=1.00$	−0.30	−1.0	−1.7

[a] Based on equation (1) with $e=10$.

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run, to the extent that the production function is not linear and homogeneous and the market is not in equilibrium, the estimates based on equation (1) are subject to error. An alternative would be to use Tolley and Smidt's [12] model, but it was deemed to be too cumbersome for the purposes of this paper.

[2] In agriculture $-n$ is probably less than σ.

[3] The short run (1 to 2 years) and intermediate run (5 to 10 years), for purposes of this study, correspond respectively to the low and high values of $-n$ and σ.

to decrease by 2 percent in the short run and 10 to 20 percent over a longer period of time, *ceteris paribus.*

Extent of unionization

The influence of unionism on labor costs and employment depends upon the extent to which unionism occurs and (indirectly) upon the extent to which employers increase wages and improve working conditions to avoid unionization. Varden Fuller [2] identifies the following as forces that appear to favor the growth of unionization and collective bargaining in agriculture: (a) vertical integration; (b) more active and sympathetic public interest based on civil rights, minority groups, and related causes; and (c) extension of NLRA. However, Fuller observes that no sudden and sweeping wave of farm labor unionization is in prospect because of the following factors that tend to constrain it: (a) farm employment will continue to be predominately in small-scale, broadly scattered units; (b) seasonal workers are not generally responsive to unionization appeals (e.g., only 8 percent of farm workers in California in 1964 worked only for one employer and only in agriculture [2, p. 431]; (c) high cost of organization of farm workers; and (d) administrative and legal frictions under NLRA coverage with respect to bargaining agents and eligibility of voters.

I concur with Fuller's assessment. The lack of NLRA coverage has sharply constrained farm worker unionism. But the extension of coverage to farm workers does not necessarily mean that widespread unionism will occur. Indeed, it's an open secret that some major union officials have been less than completely enthusiastic, optimistic, and aggressive on farm worker unionization issues. Their stance, however, has apparently been emboldened significantly in the past year as they have increased their commitments of time, energy, money, and prestige to unionization of farm workers. This may quicken the passage of legislation and the spread of unionism.

The extent of unionism in agriculture will vary considerably among regions, farm sizes, crops, tasks, and type of worker. In certain areas, for example, the grape, fruit, and vegetable areas in California, a high proportion of hired farm workers might become unionized. In the Corn Belt, Great Plains, and South, farm worker unions are not apt to become important. Seasonal workers such as students and housewives are not apt to join or be interested in unions.

An upper limit estimate of the extent of unionism in agriculture would be the share of farm workers who might become eligible under the NLRA if and when it is extended to agriculture. The $50,000+ value of farm sales is the coverage criterion most likely to be adopted since that is the one that applies under present NLRA provisions for agriculturally related industries. (Sales criteria for coverage of certain other industries are much higher.) If the $50,000+ criterion were adopted, about 100,000 farms, 565,000 hired workers, and $20 billion of farm sales would be eligible for coverage (Table 2). The other possible criteria would have about one-half this level of coverage.

Earnings and labor cost impact

Unionization will probably occur first on the larger farms (500 or more man-days of labor in the peak quarter) that are presently covered by the minimum wage provisions of the Fair Labor Standards Act. There are striking contrasts between these covered farms and non-covered farms [15]. For example, from May 1967 to May 1968, hourly wages on covered farms increased 16 percent or double the 8 percent increase on non-covered farms [15]. These data, however, are single week observations and thus must be interpreted cautiously.

Table 2. Estimates of unionization coverage eligibility in agriculture for four criteria

	Farms employing one or more workers[a]				All farms[b]	
	Farms		Hired workers		Value of farm sales	
	Number	Percent of total	Number	Percent of total	Sales	Percent of total
	thousand		*thousand*		*billion dollars*	
Total	1,317	100	1,162	100	46	100
Sales:						
$ 50,000+	100	8	565	49	20	43
$100,000+	30	2	400	34	12	26
Man-days in peak quarter:						
500+	30	2	523	45	12	26
Wage bill:						
$10,000+	49	4	600	52	12	26

[a] Based upon [15].
[b] Based upon [14].

The alternative values of λ and average union/non-union relative wage effect can be used to estimate the possible impact of unionism on employment, earnings and labor costs (Table 3). The calculations in Table 3 suggest that: (a) employment would decrease by 0 to 5 percent in the short run and 10 to 15 percent in the longer run, and (b) weekly labor costs (earnings per worker times number of workers) in the short run would be 5 to 12 percent higher and in the longer run 0 to 20 percent lower than otherwise, *ceteris paribus.* The stable or decreased labor costs are due, of course, to the elastic value of λ.

A 5–12 percent increase in labor costs will not have a very large impact on total costs of production. For example, large commercial farms ($100,000+) had sales in 1964 of about $8.1 billion and hired labor expenditures of about $1.1 billion. If all of these farms were unionized, short-run labor costs would increase by $55 to $132 million, or 0.7 to 1.6 percent of total sales. However, on certain large commercial farms (tobacco, vegetables, and fruits and nuts) hired labor expenditures are about a third of farm sales, and the impact on total production costs would accordingly be greater.

Table 3. Estimated earnings and labor costs for alternative levels of influence of unionism on wages and derived demand elasticities for labor

Item	$\lambda = -.2$		$\lambda = -1.0$		$\lambda = -2.0$	
	Wage increase of unionism					
	5%	15%	5%	15%	5%	15%
	Percent change					
Number of hired laborers	−1	− 3	−5	−15	−10	−30
Hourly cash earnings	+5	+15	+5	+15	+ 5	+15
Weekly labor costs[a]	+4	+12	0	0	− 5	−15

[a] Example of computation: If unions increase wages by 5 percent and $\lambda = -.2$, number of workers will decrease by (5)(.2) = 1 percent and weekly labor costs will increase by 5 percent − 1 percent = 4 percent. Earnings per worker will increase the same percentage as wages, assuming hours per worker remain unchanged.

In addition to the likely effects on wages and employment, unionism may affect product mixes and factor combinations. I have not estimated the product mix and factor combination effects. In general, one would expect that there would be an accelerated shift to less labor intensive crops and more mechanization. The costs of producing crops such as strawberries and fruits, which are not presently nor soon likely to become mechanically harvested, will increase relative to crops such as tomatoes, cotton, and field crops, which are machine harvested. Production of those crops that have increased costs will tend to decrease, while their market prices will tend to rise and/or net imports (exports) to increase (decrease).

The likely short- and intermediate-run impacts of NLRA would be an increase in direct labor costs (money wages) and a reduction in employment. The impact of unionism might be substantial for employers and hired farm workers in certain regions, but the effects at the national level will likely be inconsequential in terms of labor costs and employment.

Longer-Run and Dynamic Productivity Impacts

The previous section has treated the likely shorter-run impacts of

NLRA in a largely static equilibrium framework. We now consider some of the likely longer-range and dynamic impacts of NLRA—especially those pertaining to labor productivity. Unfortunately, apparently no reliable nor conclusive empirical evidence is available which could be used to examine more adequately the longer-range and dynamic impacts. Thus, although this section will be even more speculative than the previous one, it is in my view of equal importance in assessing the possible impacts of NLRA.

Unions supply many services in addition to providing representatives for one side of the bargaining table. The NLRA extension may decrease the employers' labor recruitment and negotiation costs, reduce labor turnover and disruptions, encourage worker training programs, create pension, retirement and group health programs, etc. These are potentially significant benefits for the employers, as the unions may provide these services more efficiently than the individual employer. Furthermore, to the extent that turnover, reduced seasonality, training, and retirement programs result, the burden on those paying the welfare costs of the workers will be reduced. These factors may contribute to increased labor productivity and reduced labor costs.

Leibenstein [4, p. 62] has observed: "The extent to which labor is maintained will determine to some degree the amount of effort (or units of work) that will be forthcoming. The amount of work that the representative laborer can be expected to perform depends on his energy level, his health, his vitality, etc., which in turn depend on his consumption level (which depends on income level) and, most directly, on the nutritive value of his food intake."

This interesting possibility that a worker's productivity increases with his income and *vice versa* is often overlooked. Workers are typically viewed and analyzed within the same (static) theoretical framework as are other inputs. This is a fundamental misconception, as it overlooks that increased earnings may increase productivity by (1) acting as an incentive for workers to improve work efficiency; (2) attracting more productive and more regular workers, and (3) enabling and stimulating workers to make investments in themselves and their children's health, education, nutrition, etc. If we restrict our analysis of increased wages to the short-run static effects on costs of production discussed in the previous section, we inevitably will arrive at the conclusion—overt or covert—that increased wages may be good for the individual receiving them but is bad for those that pay them.

It might be objected that, although earnings may affect the worker's productivity, the increased labor costs have to be paid by someone. Therefore, those that pay the increased labor costs must reduce investments in themselves. Thus, it is allegedly "robbing Peter to pay Paul."

This would be true if all low wage earners had sufficient income and incentive to invest in themselves or ready and equal access to public programs of education, health, housing, nutrition, manpower, collective bargaining, etc. That this is not the case for many hired farm workers, low income farmers and others, is well documented [9, 15].

A "cheap farm labor policy" has been fostered by public policies, some of which are being reversed, such as importation of foreign workers, exclusion from most labor and social welfare legislation, school closings during harvest, state recruitment agencies, discouragement of industrialization in rural areas, tying farm programs to land ownership rather than to labor input, low welfare payments, discontinuance of food assistance programs during harvest, use of inmates during harvest, etc. A cheap labor policy, as Hla Myint [7] has explained, perpetuates a "vicious circle" of low labor productivity and low labor earnings.

This perpetuation does not necessarily follow the pattern in which the son is doomed to inherit his father's poverty Downward intergenerational occupational mobility rather than "inheritance of poverty" is the main route to farm wagework [2, p. 433]. As Fuller [2, p. 434] observes, "people have not become poor from working in agriculture; they have become agricultural workers because they were already poor." Few seek or indeed have a career as full time regular hired farm laborers. For many, if not most, hired farm work is a temporary expedient and/or a last resort. Thus, many hired farm workers have low educational levels and low skills. Farm worker employers justify low wages by noting that they pay "the going rate" or "what they're worth." Thus, the vicious cycle of low wages which attract low productivity workers becomes firmly entrenched.

No quantitative "guesstimates" of the costs and benefits of these long-run dynamic labor productivity and efficiency relationships will be made. "Plausible values" for the needed parameters are unavailable, or at least I have not found any. Even the direction and qualitative attributes of the impacts are open to debate. For instance, the "backward bending supply curve of effort" thesis suggests quite a different set of impacts and implications than the forward sloping one. Even if we reject the backward sloping thesis and (correctly) accept the forward sloping thesis, no reliable quantitative measures of impacts appear feasible at this time. As tentative hypotheses, I predict that the likely long-run dynamic contributions of NLRA extension would include: (1) more orderly, stable, and formal employer-employee relationships with less disruptive and potentially dangerous conflicts; (2) upgrading of productivity and occupational status of farm work; (3) improved employment conditions and incomes of farm workers; (4) reduced labor supply uncertainties; (5) reduced wage differentials; (6) new institutional and/or technological means of coping with seasonal peak labor demands; and (7) increased competition among farmers for workers. These contributions will not be without costs, and innovative proposals will be needed to assure that the optimal benefits are achieved. Nevertheless, the likely impact of NLRA extension does not appear as unpalatable or inimical to employers' interests as short-run static analysis suggests.

Summary and Conclusions

The resolution of all the labor and poverty problems of U.S. agriculture does not rest on the passage or defeat of the extension of NLRA to farm workers. To view the NLRA as either a threat or a salvation is to ignore many of the other structural and social changes that are occurring. From the short-run static point of view, the impact of the NLRA would probably be to increase slightly total labor costs and, to a somewhat greater extent, earnings of covered farm workers above what they would be otherwise. The aggregate impact at the national level is likely to be quite small. Most workers will support the extension of NLRA and most farmers will oppose it. The long-run dynamic implications are less tractable but nevertheless potentially more significant. The potentially beneficial and "positive sum game" impact of NLRA extension to agriculture is its contribution to breaking the vicious circle of low wages which attract low productivity workers and *vice versa.*

NLRA should not be viewed as a cure for rural poverty even though it may lead to increased food prices, which in turn might serve as a partial umbrella for small self-employed farmers. Most rural poor are either aged, infirm, uneducated, or nonfarm workers—not hired farm workers who might qualify for coverage. Furthermore, increased hourly wages will be of little significance unless the number of hours of employment per year are increased and underemployment reduced. Underemployment, low skills, poor health, and inadequate education are problems that will require a broad-based national commitment to alleviate poverty, disease, and ignorance. This is not to imply that NLRA would not contribute to alleviating certain poverty-related and economic development problems. It is to emphasize that the problems cover a broader range of issues than the NLRA is designed to prevent and/or alleviate.

Those who believe that farm workers are paid their marginal value products and view unions as "market distorters" which violate Pareto marginal equilibrations of our perfectly competitive economy will be apprehensive about the extension of NLRA to farm workers. I, too, am apprehensive, but for different reasons. My apprehension is not that the NLRA will upset the equilibrium of our perfectly competitive economy, but that it will not be structured and implemented in such a way as to break the vicious circle, reduce the market imperfections, and improve the low worker skills and productivity that I believe already exist.

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TOWARD BETTER UNDERGRADUATE TEACHING

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Can Better Teaching Be Learned?

LAWRENCE BRADFORD

TEACHERS can develop and teaching can be improved if: (1) the teacher likes to teach, i.e., has a dedication; and (2) there is a favorable environment, including a renewal of emphasis on teaching vs. research.

Emphasis at universities for the past 8 to 10 years has been to disfavor either improvement in teaching or a desire to teach. Rewards and promotions have been made largely on the basis of published papers. Hence, the slogan "Publish or Perish." However the current demand by students on university campuses calls for a better grade of teaching. This demand will increase.

For most courses in undergraduate teaching of agricultural economics, I see little correlation between teaching and research. That is, there is a meager amount of information gained in current research projects daily useful in the content of the specific course. This is not to say that research in agricultural economics is not important. It is to say that when doing teaching, one should not be pulled away toward completing a research project. There is probably more correlation for good teaching between current extension activities and teaching.

On the other side of the equation are the personal desires of the teacher. He must first of all like people as opposed to things or innovations. He must develop enthusiasm for his subject and believe that it is important that students gain the information he has to impart. My former students comment more on my concern, my illustrations, and aside remarks than on their acquirement of the theoretical aspects of economics. In other words, humanism and application are essentials of good teaching.

Next, a word on work. The good teacher must work harder and longer hours than he expects of his students. He needs an hour for fresh and renewed preparation for daily presentations immediately before each class. Old lecture notes should be discarded. That is, he needs to have clearly in mind what he will present, a time schedule, a method of presentation, charts and illustration materials arranged, and assignments clearly prepared. Perhaps he will spend more of the class hour on assignments than on the lecture.

Now with regard to assignments of the practices, problems, papers, etc.,

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students are to prepare. Ideally there should be some exercise for students to hand in each class period, or longer ones each week. Students do no more work than is required of them. In later years, your rewards will come largely from the useful and understandable work you help them to do. Let us constantly remind them that the term education derives from the Latin *educere,* which translated means lead out—not pour in. Writing things involves thinking, the basis of education.

Preparation of exercises to be submitted will require work months or weeks ahead of the class beginning. They will need to be revised from year to year.

Self evaluation is important. This can best be accomplished by having your students grade you on a number of items such as clarity of assignments, voice control in lecturing, fairness in grading, understanding of course objectives, usefulness of course content, and application of the items of economic theories.

May I suggest that you secure a copy of a bulletin of The American Association of Colleges for Teacher Education; namely, *Student Evaluation of Teaching and Learning!* It is an excellent and comprehensive guide for developing questionnaires for obtaining the help of your students in measuring your own performance.[1]

The teacher must formulate a specific set of objectives. The author has found the following list to constitute an inspiring basis for course content for the beginning three-credit course.

Specific objectives:

1. To acquire an understanding of the problems of agriculture as a whole, i.e., to learn about agriculture as the composite of farming with those institutions, businesses, and industries directly related to farming.
2. To measure the place and to find the importance of farming and agri-business in the national economy, i.e., its size, its contributions, and its influences.
3. To acquire some understanding of the economic principles that govern the actions of farmers and those who buy from farmers and sell to farmers.
4. To learn how to use principles to put the resources used in farming together so as to make profits.
5. To learn more precise meanings of some 200 economic terms used in agricultural literature.
6. To learn how to read, interpret, make and use some of the elementary tools, such as graphs, charts, and indices.

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[1] Order from Edward C. Pomeroy, Executive Secretary, The American Association of Colleges for Teacher Education, 1201 16th Street, N.W., Washington, D.C. 20036. Price, 50 cents.

7. To refine some common statements and thinking about price and production problems, and to reduce them to generalization or principles.
8. To consider the part of governmental programs in farming.

General objectives:

1. To improve written and spoken English.
2. To gain practice in uses of the scientific processes.
3. To develop some confidence, particularly in the making of economic decisions.
4. To foster pride and assurance in rural living.

Now, a word on grading. Levels of grades largely reflect the level of teaching. Each student's grade indicates the quality of teaching the teacher has accomplished with that student. If the student flunks the course, the teacher flunked also. He failed to motivate, explain, assign, check, or something. Again, I have never been able to see why a teacher desires to flunk a given number of students or to argue over one-half a percentage point on a grade.

I have been impressed by the similarity of performances of the teachers who have been nominated for our undergraduate teacher awards over the past three years. A number of them have been given the Outstanding Teacher Award of their respective colleges. These men have generally:

1. Taught large numbers.
2. Motivated their students, i.e., made friends of them.
3. Counseled and visited with students outside of class.
4. Advised with student organizations.
5. Participated in teachers' conferences.
6. Written articles on teaching.
7. Participated in off-campus activities.

Finally, a word on the costs and rewards of teaching. As I pointed out, emphasis for the past 8 to 10 years has been on research. Many teachers thus suffer rank and monetary losses in advancement from heavy teaching loads. This will change and is largely a short-time cost. In the long run, most of you will be better remembered as teachers than as research workers. Teachers' lives live on in the lives of their students. Bulletin writers are generally little accredited outside their own department and rarely known outside their own profession. This is true even for the outstanding agricultural economists. Even you, I dare say, know Schultz, Schickle, Black, Taylor, and Warren, for example, more as men and as teachers than you do for the research projects they carried on or the bulletins they wrote. This is even more pronounced with regard to the citizens of your own state. Satisfactions from teaching increase at an increasing rate. Satisfaction and recognition are life's greatest awards.

Toward Better Undergraduate Teaching

G. T. Dowdy, Sr.

To begin, teaching may be defined as the stimulation of learning concomitantly with learning, which may be defined as an active process carried on through doing, reacting, and sometimes undergoing changes and the like; and for both of these to be effective, the learner must participate in his own learning-teaching situation, hence his own education.

Methods of teaching are our "tools," which we use systematically to stimulate the processes of learning. Therefore, methods must of necessity take into proper account the nature of learning and the nature of the learner. To be effective, experience indicates that methods must also recognize the desired outcomes of learners, and they must be considered with learners of differing backgrounds and of differing levels of maturity, etc. I hasten to add that the teacher must play the role of a counselor following classes in order to study and arrange for proper adjustment in his approach to any differences that may exist among students. At this point, it is necessary to bring into this presentation a few words concerning methods. Occasionally, one may consider or interpret techniques and devices as methods; however, these are only parts within methods. Therefore it is not surprising that considerable confusion exists in the teaching circle through misinterpretations of the meaning of the word "method."

The following list will serve to telescope the situation—some people refer to the following as methods: recitation, textbooks, individual, project, study, socialized, drill, group, and visual.

None of the above is a method; each is a subsidiary technique, a device, or part of a method [1, p. 866B].

Over time, advances in the complexity of learning, coupled with the rise of an intellectual tradition of tribal history, brought about the development of the first teaching methods. These involved demonstrations of skills to be performed plus enforcement of drill or practice. Initially, the use of deductive logic produced many erroneous beliefs because the original premise was predicated on many unrealistic assumptions. Yet, the deductive method is nonetheless a sound teaching method especially in specialized subjects with college students. The basic principle used in the deductive method involves generalization of a law or idea together with illustrations. Employing this method, the student is led to analyze the principle and examples and then to find new ones in his general field of study. It is expected that the student or learner will use conservatism relative to limitations.

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Another method that should be mentioned is the inductive method, which presents the means for the verification of hypotheses. The essence of this method may lie in the belief that knowing and learning started with the observation of the world around the students, who would scrutinize the facts and problems related to them; this would, in turn, entail the development of hypotheses to guide and perfect the search for any additional facts. Such a method of teaching urges students to observe and analyze certain phenomena in the world, which will permit comparisons over a series of specific instances, and finally to distill some worthwhile generalizations. While this is an ideal approach to teaching, some teachers still use means that pound facts into the student's head to be memorized and given back in recitation.

Perhaps the two most dominant general methods of teaching are (1) the assign-study-recite-test procedure, and (2) the unit approach. These are useful for differing purposes, with differing levels of the student's maturity and advancement. Each of these methods can at time be subjected to abuse; yet each is dynamic, and improvements appear regularly as time passes.

Obviously, there are a number of factors that will improve undergraduate teaching, provided that some can be supplied and perhaps others removed. It is the general opinion of many that perhaps the most significant factor relevant to our subject is the college's own commitment to "excellence" in undergraduate teaching and the extent of support it gives to the aggregate phases of the teaching. To name a few: the level of support to research in connection with teaching; teaching loads; rotation in teaching assignment with respect to periods (hours); teaching loads with respect to assignments for the same course but different sections contrasted with teaching loads for different courses; the extent of *teacher-student* involvement in design and preparation of the evaluative instruments; adequacy and accessibility to the library; physical teaching facilities, inclusive of modern classrooms that would at least be as adequate and well appointed as the classrooms students enjoyed in high school; reasonable supply of audio-visual and other teaching aids (i.e., charts, diagrams, exhibits, films, film strips, globes, maps, models, photographs, pictures, posters, radio, TV, samples, slides, and teaching assistants).

The second most important category would be the teacher himself. Undergraduate teaching cannot be improved unless we bring into the teaching circle teachers who are dedicated and have a strong desire to teach and, moreover, those who have a high level of enthusiasm, optimism, initiative, resourcefulness, some sympathy, good personal habits (for these serve as valuable examples), integrity. They must realize also that their responsibilities as teachers extend far beyond the classroom itself; and they must have the foresight to "size up" and "face up" to students' vary-

Better Teaching—Some Curricular Aspects

LESTER V. MANDERSCHEID

BETTER teaching can be approached in a variety of ways including creation of a better environment for learning, more careful attention to class preparation, examination techniques, changed motivations on the part of students and others. All are important, but I want to focus on another dimension—the dimension of what is to be learned.

In addition to all the other attributes of good teaching, it is clear that one of the teacher's major roles is guiding the studies of students under his direction. Before a curriculum can be evaluated, we need to assess our student audience and define our educational goals. I assume that our educational goals involve developing the student into an educated man and into an applied problem solver with special emphasis on the practical social science problems of individuals or groups either in agriculture or in rural areas.

The next two sections center on the changing nature of current and potential students in agricultural economics and the changing nature of agricultural economics departments. These changes will then be related to curricular implications and the need for our involvement in planning the total curriculum, not just the allocation of credit hours. If taken seriously, total curriculum development is not an easy task. But too often we take the easy way out—we merely divide the curriculum into areas by credits and assume that our students receive an integrated total education.

Changing Nature of Students

To properly evaluate our curriculum, we need to recognize how today's students differ from previous ones. We must consider both the students currently enrolling in agricultural economics and those we believe should be enrolling in agricultural economics. It is this often overlooked potential market that holds the promise for an increased demand for the services of agricultural economists in undergraduate education. There are four ways in which I believe our students differ markedly from those of a generation ago. These four ways can be classified as (1) fewer with a farm background, (2) fewer planning to live in rural areas, (3) a more sophisticated academic background, and (4) an increased awareness of societal problems. Now let us briefly consider each in turn.

It is well known that many agricultural colleges now find that a large and increasing percentage of their students were reared in medium size

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cities or metropolitan areas. This phenomenon is common also to the non-land grant colleges where a large percentage of students in agriculture now enroll.

Coupled with the changing pattern of students' previous living areas is their plan for future locations. A large percentage of our graduates in agricultural economics, as well as in agriculture, now expect to spend their professional careers living in urban areas.

High schools have moved rapidly to improve not only their science but their total curriculum. This improvement has been accelerated by school consolidation. Furthermore, this is the age of television, which has provided students with a great deal of knowledge in spite of its "vast waste land of entertainment." These forces combine to more than offset the effects of a larger number of high school graduates going to college.

A fourth change in our students is their increased awareness of societal problems and their concern for helping to solve these problems. In part, this reflects the affluence of the mainstream of American society amidst poverty and prejudice. In part, it reflects concern about an unpopular war and the fact of three shooting wars involving the United States in the last 25 years. In part, it reflects the greater sophistication of students brought about by the instant communication of television, increased travel, and improved secondary schools.

Changing Role of Agricultural Economics Departments

Associated with the change in the nature of current and potential students is the changing nature of departments of agricultural economics. Many departments are now engaged in graduate education at the Ph.D. level and in some, probably too many, there has been a tendency to emphasize graduate education to the detriment of undergraduate education. This tendency manifests itself in several ways. One is the shift of faculty interest and attention from the undergraduate to the graduate student and from the "average" undergraduate to the potential Ph.D. student. Another more subtle aspect is molding of curricula at the undergraduate level in the direction of preparing students for Ph.D. programs. While this is a laudable goal for many undergraduates, there is a tendency to warp the curriculum for all students in this direction.

One should not overlook the growth in agricultural enrollment, including agricultural economics, in the non-land grant schools in the last 25 years. Many faculty at land grant institutions are surprised at this development and express amazement when they learn of students who choose the non-land grant schools in their state when "the land grant college of agriculture has so much greater prestige." Yet, many outstanding students are thriving on the attention paid undergraduates and their needs in some of the non-land grant schools.

Curricular Implications

In this section I will raise questions in four areas of curricular concern. These questions arise from the previous observations on the changing nature of students and departments and from my involvement in curriculum planning.

1. *Are we including the right science courses in our curriculum?* Scientific advance has been rapid during the last generation and a great deal of new information is made available each year. This new information should lead to revised content in the science courses, whatever the area of discussion. For example, in the biological science area, much of the recent information has been at the molecular or cellular level on the one hand, or at the ecological level on the other. Yet, the courses traditionally included in our curricula have focused on the organismic level. Should we continue to require courses heavily oriented toward the organismic approach or should we require courses at the molecular, cellular, or ecological level, or some new survey course that covers all levels, or should students be given a choice of level? Another dimension of science that merits concern is the philosophy of science or the method of science, which is quite often discussed in the required science courses as well as in courses in methodology in agricultural economics. I believe too many students are learning *the* scientific method and too few are learning the variety of accepted approaches to scientific research that are common today.

2. *What kinds of courses in agriculture are relevant for today's students?* Students from the city often are suspicious of required technical agriculture courses. These courses are perceived to be how-to-do-it courses rather than courses than emphasize principles of value in the several potential off-farm occupations. An urban-based student interested in development, either rural development in the United States or urban redevelopment or international development, views the courses quite differently than the farm-based potential farmer. The agricultural business student fears that the emphasis on marketing of farm products will be at the expense of his understanding the marketing of inputs or of processed products in an imperfectly competitive firm.

3. *Are the social science courses that we require relevant to the student's concerns and interests?* With students' greater sophistication and greater social awareness, do the required social sciences courses help them understand social science conflicts that are or will arise in society? Our students need to learn not only the economic but also the political, psychological, and social aspects of social science analysis. Further, they need to see these aspects as part of a system, not as isolated components to be treated independently.

4. *Do the required humanities courses develop in students an awareness*

of value formation and the resolution of value conflicts within a human society? Students are aware that many current and potential problems involve value conflicts, but they often find the required humanities courses seriously deficient with respect to how values have arisen, how values change, and how value conflicts are resolved. Indeed, many students and graduates find great difficulty in relating humanities courses to current societal problems, let alone the resolution of these problems.

Even though this is an incomplete list of curricular concerns, it is obvious that we in agricultural economics cannot resolve all of these questions by ourselves. Rather, we must engage in dialogue with the faculty who teach in the various areas.[1] They are subject to many of the same pressures that we are—the pressures to publish, to produce Ph.D. graduates, to keep up with the latest literature, and, faint though it may seem, to better teach undergraduates. But we cannot simply allocate "x" percent of our curriculum to a given area and then let the faculty in that area exclusively decide content.[2] A student's education is whole, not a sum of parts. It is our responsibility as undergraduate advisors and curriculum builders to insure that our majors receive a whole education by actively engaging in the development of the whole curriculum.

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[1] A number of highly useful study papers and reports have been prepared under the auspices of and are available from the Commission on Education in Agriculture and Natural Resources, National Academy of Sciences, 2101 Constitution Avenue, Washington, D.C. 20418.

[2] Of course, this is a matter of degree. We should help specify general content but not all of the details.

Inter-University Collaboration in Undergraduate Teaching

V. James Rhodes

LAST winter I suggested to President Breimyer a session at this meeting for the teachers of a particular undergraduate course. The session was to be a mini-workshop on goals, course content, and teaching materials; its objective, a fruitful exchange of ideas and materials, including, perhaps, the stimulation of joint efforts to develop new materials. The infrequent AAEA workshops on teaching improvement appear to concentrate on philosophy, psychology, and techniques of teaching. The neglected area seems to be teaching materials for specific courses. Our president didn't buy that workshop idea; instead, he commissioned me to talk about it here today.

As I thought about a paper on this topic, I realized how little I knew about the extent to which there is such cooperation among teachers and their attitudes on such matters. It seemed likely that my ignorance was fairly general. So a survey was born.

Two-page questionnaires were sent to the agricultural economics departments of the 50 state universities to teachers of five undergraduate courses: Principles, Marketing, Farm Management, and Prices or Cooperatives. I received 119 replies.

Current Practice

Two out of three of these 119 teachers have exchanged or received teaching materials pertaining to their course from outside colleagues.

How has such sharing occurred? Much of it has occurred through correspondence or through visits to other departments. Apparently, very little of it took place at workshops, symposia, etc.—probably because so very, very few have been related to teaching materials. Sharing of materials occurs most often between acquaintances; for example, instructors exchange with their ex-students.

What kinds of teaching materials are exchanged? You won't be surprised that course outlines led the list with 51 percent of the mentions. A distant second was reading or reference lists, 12 percent.

There is an interesting discrepancy between the rather limited variety of materials exchanged and teachers' attitudes as to what can be usefully exchanged. All 119 teachers were asked to select from a list the kinds of materials they thought could be usefully shared. The course outline—

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checked by 70 people—was the leading item. However, other items were listed very frequently. For example, only 15 people had actually exchanged reading or reference lists, but 49 of this larger group listed it as a useful exchange item. Problems and exercises were listed by 56 teachers, visual aids by 42, examinations by 32, and lecture notes by 29. In other words, teachers are saying there is a rich variety of materials to be exchanged—a potential that exceeds by several-fold the present usage!

Length of experience effect. To check the possible effect of length of experience, the teachers were divided into the "less" and "more experienced" groups on the basis of whether they had taught this particular course five or more times. "Experience" in this context refers to a particular course, although it is substantially related to longevity as a teacher. Sharing of materials was reported by about 78 percent of the more experienced, compared with 52 percent of the less experienced. These percentages should encourage the new Ph.D. who occasionally may labor under the fear that seeking of assistance indicates some deficiency of energy or intellect.

Is the new teacher or the more experienced likely to benefit most from the exchange of materials? The response was that the newer teacher may particularly benefit, but there definitely is no generation gap in this game. Many older teachers wrote eloquent comments to the effect that the experienced teacher needs the continual stimulation of new ideas and materials to keep his course relevant and alive. There is no thought that anything as complex and personal as a course outline or an examination can transfer in entirety from one person to another. The name of this game is stimulation.

What role, if any, should be played by AAEA in facilitating this sharing of teaching materials? Only 16 felt that AAEA did not have a role. However, 59 people suggested a clearinghouse role for AAEA, 36 mentioned the sponsorship of workshops or seminars; and 16 suggested special efforts at our annual meeting, including special sessions on particular courses, exhibits of teaching materials, etc. For example, one teacher suggested an afternoon session on teaching of some particular course, with the price of admission being copies of your own teaching materials.

Let's examine further the two most popular suggestions: (1) that AAEA provide a clearinghouse, and (2) that it sponsor special workshops or seminars. The clearinghouse idea seems to mean various things, including:

(1) a published list of who teaches what and where; a modification is a published list of teachers and the kinds of materials they have volunteered to share;

(2) a central file of teaching materials, with copies available for a fee;

(3) an annual published summary of course references and subject areas covered in particular courses;[1]
(4) national committees to collect, pool, and disseminate materials.

Participation in any clearinghouse scheme should be entirely voluntary, of course.

We asked: "Would you be interested in participating in a workshop session devoted to the objectives, content, and teaching materials of your course?" Eight of every 10 said "yes", one said "maybe", and one said "no". About 3 out of 10 teachers had attended one or more of the AAEA symposia on undergraduate teaching such as the one at Virginia Polytechnic Institute in 1966.

Summary

Let me recap and editorialize. Teachers are interested in sharing materials, and this interest is as genuine for the veteran as for the new teacher. Two-thirds of the teachers have substantiated such interest by already exchanging materials relating to a course they are now teaching. However, the potential has not nearly been reached as to the number of teachers exchanging and especially as to the range and variety of materials exchanged. Group cooperation could facilitate the development of new teaching aids—visuals, film loops, programmed learning texts, etc.

Most teachers believe that AAEA should play a facilitating role. First priorities go to workshops geared to course content and to a clearinghouse approach. When 9 out of 10 teachers are interested in such workshop sessions, I think that is a pretty clear mandate. The clearinghouse approach can perform a function complementary to the workshop approach.

The variety of clearinghouse suggestions represent various stages of possible development. I suspect most of us would settle for an elementary beginning that has the potential to grow. To that end, I'm volunteering my services (really my secretary's) for the next year for a pilot operation of an elementary clearinghouse. I propose to provide a who, what, where list of volunteer participants. About March 1, 1970, I'll send out a list of those teaching a particular course who are willing to exchange materials, and the kinds of materials. The only way to receive the list is to volunteer before February 15 to exchange such materials. I will not solicit volunteers. I won't reproduce or transmit materials.

This is a one-year commitment. If there is significant response I will carry the story to the AAEA officers and ask them to adopt our baby. I hope that I'm not thought to be presumptuous in my volunteering. I appreciate, on the one hand, the slowness and caution with which the association must move, and, on the other hand, I believe that you teachers have said in this survey that you want to move.

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[1] ODE, the Honor Society in Economics, does something similar. In their journal, *The American Economist*, selected reference lists and reading assignments of a few leading teachers are published.

Teaching can be improved. This exchange is one way it can be improved. Let's do it.

EXPERIENCES IN RURAL ECONOMIC DEVELOPMENT

CHAIRMAN: HENRY J. MEENAN, UNIVERSITY OF ARKANSAS

Problems that Persist in the Great Plains*

JOHN MUEHLBEIER

THE Great Plains is a vast region that extends from Canada nearly to Mexico. Its western boundary is formed by the Rockies. No clear demarcation exists for the eastern boundary, which is a wide transition zone extending from eastern North Dakota south into Texas [13, pp. 23–42].

The region is characterized by variable precipitation, extremes of temperature, a complex pattern of soils, a short growing season in the north, high evaporation in the south, high wind velocities, and high drought frequencies.

The average rainfall in the transition zone is near the critical limit for the production of crops. In many years, crops are good but in those years when rainfall is a little below average, or not very timely, crops fail. In the more humid region to the east, this is much less of a problem and in the arid region to the west, no problem at all.

The region is sparsely populated and largely agricultural. It produces much of the nation's wheat and range livestock.

Institutional Adjustments

The nation is currently much concerned about the social cost of space resulting from the extreme concentration of population in large cities [6, pp. 1–26]. In contrast, the Plains has long been concerned about the social cost of space resulting not only from sparse but also declining population.

Adaptation of governmental services

Nearing 40 years ago, Walter Prescott Webb [19] contrasted the settlement of the Plains with regions to the east by saying that an institutional

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"fault" exists, somewhat comparable to a geological fault, running from Texas to the Dakotas. He wrote that "practically every institution that was carried across it, was broken . . . or else greatly altered" [19, p. 8]. For example, the various local governmental units, school districts, road systems, health services, and other institutions brought into the Plains were poorly adapted to the region. Adjustments have been made but much remains to be done [7].

The main problems with reference to local governmental units and schools are (1) high cost per capita, (2) low quality of service, and (3) burdensome taxes. For example, where the national average is more than 1200 persons per governmental unit, the average in some states in the Plains is less than 150 persons. Many of these units have neither the population nor tax base to support the necessary services [10, p. 29].

Health planning

Similarly, health planning in the Plains is also made difficult by sparse and declining population. The main problems in this field have been, and still are, providing (1) health personnel, (2) quality care, (3) financial support, and (4) health facilities. Much remains to be done in this field, particularly in providing and in raising the quality of care [4].

The organization of services and facilities so that good medical care is available in the Plains is a challenge. This includes provision for emergency care where distance and time are critical factors. It involves an upgrading of hospitals, particularly strategically located smaller hospitals, and the development of liaison among all hospitals.

Development of service centers

The Plains is a region of many small towns, some of which are declining still further because of loss of population from the region. For example, in one state less than 10 percent of the towns with a population of 2500 or less were found to be growing, and only those 15 towns with a population of more than 2500 persons were believed to have much of a future [18, p. 17].

The challenge is to plan for such towns or service centers as may be needed in the years ahead, considering both the public and private needs. This is a very difficult task. All of the present towns can not expect to grow and none can expect to provide the whole range of services needed. A plan for orderly adjustment and growth is needed [9, 316–345]

Some private firms have announced plans to develop new service centers. These firms may have the funds to build centers but whether they also have the necessary information remains to be seen. With technical help and adequate planning, the people already in the area should be able to provide the necessary services and thus avoid being replaced by new centers.

Lag in adjustments

Other needed adjustments could be discussed but perhaps the question should be raised as to why this lag in adjustment continues to exist.

For local leaders to work effectively in this field, they need relevant information, they need to understand the inter-relatedness of the several problems, and they need to take into account future needs of their community [2]. Local people seldom have much information or technical help. This accounts for the fact that we have cases where a costly school has been built following a consolidation of districts, only to be abandoned for lack of students within a few years.

In other words, the U.S. Department of Agriculture and land-grant universities have not conducted the research on these problems, nor carried out any extension programs comparable to those that helped farmers with production problems. Furthermore, institutional adjustments require community action and such cooperation is not easily attained. Institutional changes are more likely to involve controversy. Hence, the task of providing help becomes more difficult, but the price for not doing it comes high.

Farm Adjustment

From the early days of homesteading on a quarter section, later increased to a half section, and still later to a section but restricted to grazing land, the average size of farm has increased greatly. Physical characteristics of the region required adjustments in size and type of farm, as has technology in more recent years.

Strategies in operation

The Plains Region is a relatively "high risk" area for farming and ranching [8]. The economic problems faced by operators, in large part, stem from the limitation in choice of crops and from variations in the production of crops and grass. These, along with changes in price, result in variable farm income.

Studies have shown that variability of income can be reduced. Some of the strategies suggested to reduce variability include: (1) selection of enterprises that have low variability, such as forage crops and livestock, (2) combining of enterprises that have different patterns of year-to-year variability, (3) spatial diversification, (4) crop insurance, (5) irrigation, (6) flexibility in kind and number of livestock, (7) feed and financial reserves, and (8) adapted range and livestock management systems [1].

One thing should be noted, however; a reduction variability of income often results in a reduction in total income over a period of time. Increased stability comes at a cost. For example, studies of some proposed irrigation projects show that irrigation may reduce variability of production up to one-half but the return per dollar invested in irrigation would be less than the return per dollar under dryland conditions.

Periodically some operators still find themselves in distress as bad years follow the good. Accelerated Extension programs are needed on risk and uncertainty, in which problems, causes, and alternative strategies would be discussed.

Adaptations in size

In the process of enlargement, several small farms have often been combined into single operating units. Most of these are efficient family type farms. They have adjusted and are going concerns. The average farm income from farming compares favorably in the Plains with other regions but income from off-farm employment is lower. Many low income farms are found throughout the Plains with concentrations in certain areas in the eastern part of the Plains.

Many of the smaller operators have the ability to manage a farm and also have some resources at their command. They need a line of credit so they can operate more efficiently and grow. Some of the operators on small farms do not have much future in farming but, for one reason or another, may not be in position to prepare themselves for something better. It may well be in their interest to remain on the farm until retirement and this may also be in the public interest, even at some public cost.

There is still another low-income group however, where some change in policy seems desirable. These are younger individuals who show little promise in farming or who have few resources but who could be helped to prepare themselves for other employment. It would seem to be neither in their interest nor in the public interest to extend them credit for farming, and least of all, to give them priority over others who have some chance to make it.

For these individuals, or even others who wish to make a change, alternatives need to be provided, such as loans and grants for educational purposes and possibly other help. In place of being considered only for credit, or turned away with no help, the best alternative for them should be provided.

Land Use Adjustments

When land of relatively low productivity is kept in cultivation, crop failure, wind erosion, and economic distress often result. This is especially the case in the Plains because of a large acreage of poor cropland and a variable climate.

Reduction of crop failure and control of wind erosion

In the drier periods, such as in the mid-1950's, from 10 to 15 million acres were reported damaged by wind erosion in each of three years [17]. In addition, from 10 to 25 million acres were reported in condition to blow. From 1 to 5 million acres of crops were destroyed each year during that period. Although the dust storms were more awesome in the mid-1930's than in the mid-1950's, the acreage reported damaged was greater in the '50's.

Some land once farmed in the Plains was found, through bitter experience, to be unsuited for cultivation and has since been restored to grass. A considerable acreage of low-productivity land is still farmed, however. For example, in 1957, 15.4 million acres of Class IV land were reported as cropland compared with 20.5 million acres in 1967 [16]. Similarly, in 1957, 13.8 million acres of Class V-VII land were reported as cropland compared with 10.3 million acres in 1967.

In other words, Class IV cropland increased 5.1 million acres and Class V-VII decreased 3.5 million acres. To what extent Class V-VII cropland has been regrassed or simply reclassified is not known. What is relevant to this paper is that the total of Class IV and Class V-VII is almost the same today as 10 years ago, and 10.3 million acres of Class V-VII cropland remain. In view of the fact that soil scientists consider Class IV land close to marginal for crop purposes and Class V-VII unsuited for continued cultivation, the problem persists.

Facilitating regrassing

Beginning in the late 1930's, much discussion centered on the need for an incentive for regrassing greater than that provided by an annual payment offered by the Agricultural Conservation Program and widely used by farmers and ranchers. It was recognized that the establishment of grass involved considerable risk. To reduce the risk, a contract was discussed in which the operator would be assured, before he started conversion, of annual payments for a period of years [5].

At a Drought Conference called by the Department of Agriculture in 1954, a recommendation was developed that the Agricultural Conservation Program Service be authorized to make forward commitments with regard to cost sharing on establishment of permanent vegetative cover [14, p. 3].

The Department followed up on this recommendation and sought an amendment to Section 16 of the Soil Conservation and Domestic Allotment Act. The amendment proposed that the Secretary of Agriculture be authorized "to enter into contracts . . . with producers in the Great Plains . . . to make . . . changes in their cropping patterns and land uses . . . and to install the soil and water conservation measures needed under such changed systems" [11].

In the hearing on the proposed amendment before the Committee on Agriculture in 1956, the Department estimated that it would take $112 million out of a total authorization of $150 million, or 75 percent, to convert 10 million acres of cropland to grass; $30 million, or 20 percent, to reseed 6 million acres of rangeland; and $8 million, or 5 percent, for associated measures [12, p. 6 and 13].

The proposed amendment passed and the Department set up the Great Plains Conservation Program and named the Soil Conservation Service to administer the program.

The program has now been in operation about eight years. Have the goals been achieved that were set forth? Only in part.

The reports show that less than 15 percent of the funds have been used for regrassing, about 10 percent have been used for reseeding, and the remainder, or 75 percent, have been used for other conservation measures, particularly for terraces and reorganization of irrigation systems [15]. So far, fewer than one and a half million acres have been regrassed. The problem of farming low-productive land persists.

What is probably needed is a review and reorientation of all related Department programs, including research, extension, credit, crop insurance, acreage control or land retirement programs, conservation cost-sharing, technical aid, and particularly the Great Plains Conservation Program, to make sure that all contribute as much as possible toward control of erosion in problem areas and regrassing of land unsuited for continued cultivation wherever a concentration of such land exists.

Improvement in range-livestock management

In the Great Plains Region, nearly 200 million acres are used for range-livestock production, an important resource. The main problems of the range consist of relatively low productivity, poor range management practices, inadequate strategies for minimizing adverse effects of weather and markets and maximizing the returns in the good years, inadequately developed range-livestock management systems, and high investment in land per animal unit [3, p. 47]. Ranchers in the Plains will also face competition from those in other regions. Changes in farm programs could also affect them.

Research on range and livestock management problems seems limited, considering the vastness of the range and its potential. Extension programs are still more limited. A need exists for accelerated regional research projects, of an interdisciplinary nature, on improvement of the range, development of management strategies for survival and capital accumulation, and development of range and livestock management systems. Equally necessary are accelerated Extension programs in these same fields.

Water Resources

Water is a scarce resource in the Plains. Over much of the region the average annual runoff is less than 1 inch, although in the eastern part it is from 1 to 5 inches.

Of the rain that does fall in the Plains, more than two-thirds is lost by evaporation alone. Even a small reduction in evaporation would greatly add to the stability of production. This is especially important in the effective 20-inch rainfall zone.

Accelerated research on soil-water-plant relationships and on the adaptation of plants to climatic stress would result in reduction of crop loss and economic distress. The benefits would be region-wide.

Economic Development

The largely unplanned economic development of this nation, in which population and industry were permitted to concentrate in a relatively few large cities, has taken its toll. Those in the cities have such problems as congestion and pollution. The public bears the cost of such problems as urban renewal. The Plains has the problems associated with a declining population. To date, little has been done to assure that economic growth will take place where it is the most economic, taking into account both industry and public costs.

Local economic development is, of course, encouraged in various programs but the results are rather limited and rural areas continue to lose population for lack of jobs.

In their struggle to attract industry, smaller towns compete with each other by offering concessions they can ill afford to industry often well able to finance itself. Stronger national measures need to be considered if more balanced economic growth is to take place.

Administration of Programs

The grouping of states for the administration of national programs nearly always results in Plains states being grouped with some outside the region. As many as three or four administrative regions of a single agency of the Department of Agriculture may reach into the Plains. This is also the case in other major departments of government and with many committees organized by the states. When this takes place, attention is often diverted from the problems of the Plains. They may be overlooked or overshadowed.

Just recently, Federal regional councils were established by the President. Three of these reach into the Plains. These councils may serve their purpose. Plains people will need to be alert, however, to assure that Plains problems receive due consideration and are not over-shadowed.

In conclusion, as further progress is made in the alleviation of these problems, the economy of the Plains will become more stable and the well being of its people will be enhanced.

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Rural Areas in an Urban Economy*

MONROE NEWMAN AND ELI P. MARCH

WHEN the Congress passed the Appalachian Regional Development Act in 1965, it established a new agency, provided it with a new set of operating instructions, and told it to work on a relatively old problem. That problem, of course, is the record of relatively low incomes, high unemployment and underemployment, out-migration, poor health, and inadequate education that have been generally characteristic of Appalachia—symptoms also characteristic of rural America. The approach of the Appalachian program to these problems, therefore, has significance for all rural areas of the country and, in fact, for all areas.

In the debates and discussions of recent years concerning "urban-rural balance," "rural renewal," and a national urban policy, one thread of agreement seems to exist—the intertwining of urban and rural problems. We simply cannot separate the solution of our urban and rural problems into separate compartments. The historic exodus from our rural areas has depleted their most valuable resource, their young people, who have too frequently been redundant and ill-equipped in their new urban environment. An approach to overcoming typically rural problems that holds even modest promise would be welcome in the effort to reduce problems of urban and rural areas to manageable proportions.

Another thread of agreement in the discussion of urban-rural policy, though less overtly stated, is that there is no possibility for a program to stimulate a "return to the land." For better or worse, we are an urban and urbanizing nation and national policy must both recognize this fact and, simultaneously, avoid confusing the term "urban" with "metropolitan." The former does not necessarily mean the latter, and wise public policy must capitalize on what both can offer.

There have been numerous attempted explanations of this urbanizing phenomenon. Some seek an explanation in a hierarchical structure of cities whose size and placement follow some regular pattern. Others seek it in agglomerative economies that confer pecuniary and non-pecuniary advantages. Still others seek it in an increasingly greater rate of invention and innovation as urban size increases. And there are those who seek the explanation in a higher degree of income elasticity of demand for services than for goods.

Candor requires that we admit that a preference for one of these expla-

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nations over others may be more emotional than logical. Certainly, agreement and reconciliation among them have not been achieved, and public policy is therefore left with a conclusion with which it must reckon—we are an urban and urbanizing nation—without understanding fully why we are. Not fully knowing why may be a common problem in policy-making but it is, nevertheless, a troublesome one. It is in this unsettled realm of hypothesis that the Appalachian program was created and has existed. To understand the Appalachian program's possible significance for the national debate on these issues requires knowing more about the program itself.

The 1965 Act created a new institution, the Appalachian Regional Commission, consisting of the governors of the 13 States in the Region (who together hold half the voting power) and a representative of the President. The Commission is therefore a hybrid and so is its staff, who are neither Federal nor state employees. For the first time in our history, the Congress provided a mechanism that involved the state governments directly in decisions concerning the allocation of funds among themselves and among major purposes. By itself, this institutional innovation is worthy of study because it provides an operating alternative to both the existing Federal grant-in-aid system and to the bloc grant approach, both of which have vociferous detractors. In carrying out its obligations to the Region and the country, the Commission is guided by a policy prescription in Section 2 of the Act [2]. Investments under the Act are to "be concentrated in areas with significant potential for future growth, and where the expected return on public dollars invested will be the greatest."

To implement this prescription requires two basic types of decisions that under the Act only the states can make: (1) the determination within each state of areas with significant growth potential, and (2) the establishment of functional plans to capitalize on the potentials and overcome the deficiencies of these areas. Decisions like these are not easy to make, either technically or politically, but they have been made and are the basis on which public expenditures are made.

To assist the states in these decisions, the Commission accepted a staff paper containing the following definition of an area with significant growth potential [1, pp. 4–5].

> Generally, an area with significant potential for future growth will contain two geographical elements—a center or centers, and an associated hinterland.
>
> "By a center or centers is meant a complex consisting of one or more communities or places which, taken together, provide or are likely to provide a range of cultural, social, employment, trade and service functions for itself and its associated hinterland. Though a center may not be fully developed to provide all these functions, it should provide or potentially provide some elements of each and presently provide a sufficient range

> and magnitude of these functions to be readily identifiable as the logical location for service to people in the surrounding hinterland.
>
> Some of the key relationships or "linkages" that exist between centers and hinterlands include:
>
> 1. Commutation patterns
> 2. Wholesale trade services
> 3. Educational and cultural services
> 4. Professional services
> 5. Inter-firm and inter-industry trade
> 6. Governmental services
> 7. Natural resource and topographic considerations
> 8. Transportation networks.
>
> A hinterland may itself contain secondary service centers from which the population may be more efficiently provided certain services.. Whether a center falls into the primary or secondary category depends upon the range of services provided to the hinterland.
>
> A secondary center may be identified as an area of growth potential, but its proximity to the primary center and its position in that center's hinterland hinders its future growth, and therefore the range and magnitude of public investments to be made in it. The public investment program for a secondary center must be related to the program for the growth area as a whole.

This definition clearly reflects an urban, urbanizing pattern as the design of American economic development for the foreseeable future, and the one into which the Region must better adjust itself. At the same time, it avoids establishment of numerical standards of growth potential. In a region as large and diverse as Appalachia, consisting of all of West Virginia and parts of 12 other states, with a population of close to 19 million, and containing such diverse large cities as Pittsburgh (population, 600,000) Birmingham (population, 340,000), and Ashland, Kentucky (population, 31,000), it is impossible to establish workable uniform standards. Rather, within each state, relative standards must be applied, though always within the urban, urbanizing orientation.

Another distinguishing feature of this definition is the recognition it gives to the functional relationship between a center and its rural hinterland. The relationship is symbiotic—each serves and, in turn, is served by the other. There is no intent in Commission policy to contain public investments within the boundaries of the urban center. Policy guidelines repetitiously speak of investments to "serve" an area with growth potential, recognizing that such service may be best provided from outside the center but demonstrably serving it. These same guidelines also recognize exceptional cases, cases of rural populations so remote from a center that specific public services cannot be provided to them efficiently from those centers. These people still deserve and should be provided with at least the scale and diversity of services our consciences tell us all Americans should receive.

The Appalachian effort, therefore, is guided by a new type of institution that is attempting to meld a region with highly rural attributes into the American society. It is attempting to do so by capitalizing on that society's urban bent in two directions: first, to augment the Region's urban complement to make it more competitive with its national counterparts; second, to assist its people to contribute and prosper in this society wherever they may choose to live.

Of the many issues raised by the program, two have been selected for comment here—the evolving urban pattern of the Region compared with the Nation, and the implications of this for regional and national policy.

Appalachia's Urban Pattern

The basically rural character of Appalachia is best demonstrated by 1960 rural-urban population data. In that year, when the Nation was 69.9 percent urban and, therefore, 30.1 percent rural, Appalachia was 47.3 percent urban and 52.7 percent rural. The latter was typically rural, non-farm.

From 1960 to 1966, the U.S. population grew by 17.6 million, or almost 10 percent. Appalachia's population grew by only 538,000 or 3 percent. During this period, the Region experienced a net outmigration of 606,000, a rate of outmigration well below that of the 1950–1960 decade as a whole, but still substantial. A continuing net outmigration should not be surprising; in fact, its absence would be since in the 1950–1960 decade a net total of 2.2 million people left the Region.

In 1966, Appalachia had about 5 percent of the nation's metropolitan population but its metropolitan areas received slightly less than 1 percent of the nation's metropolitan growth since 1960. This, on its surface, would not appear to be a hopeful sign since the Region's future may well be tied in substantial part to adjusting to the national urban pattern. When the relative distribution of growth and the performance of the individual state portions in the Region are examined, however, the picture becomes somewhat less pessimistic and more explicable. These data are presented in Appendix Table 2.

The population changes from 1960 to 1966 by urban size class of counties[1] in the United States reflect the nation's urban-urbanizing pattern.

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[1] For the purposes of data organization, counties are classified as follows:

Class	Definition
5	Metropolitan (included within SMSA)
4	Total urban population over 50,000
3	Total urban population 25,000 to 50,000
2	Total urban population 10,000 to 25,000
1	Total urban population 2,500 to 10,000
0	All rural

In the text, classes 0 and 1 are called rural and minor urban; 2, 3, and 4 are called moderately urban.

The only types of counties that lost population during this period were those that had less than 10,000 urban population. This pattern did not hold in Appalachia where counties of all levels of urbanization increased in population. For the United States as a whole, the total population change of 17.6 million was highly concentrated in metropolitan counties. In the Region, the total growth of 538,000 was distributed quite differently, as shown in Table 1.

Table 1. Distribution of population growth, 1960 to 1966

County type	United States	Appalachia
	percent	
5	90.5	29.4
4	3.9	5.3
3	5.4	15.6
2	1.4	24.7
1	−0.8	17.9
0	−0.4	7.1
Total	100.0	100.0

For the nation as a whole, slightly over 90 percent of the growth was in metropolitan counties. All the non-metropolitan counties with over 10,000 urban population grew by 10.7 percent. In Appalachia over 29 percent of the growth was metropolitan, over 40 percent was in moderately urban counties (10,000 to 50,000 urban), and 25 percent in rural and minor counties. Clearly, Appalachia's population is not distributing itself in a microcosm of the nation. In fact, it is showing rural and minor urban county population growth while its metropolitan counties show a rate of growth one-sixth that of the U.S. metropolitan rate of growth.

Since so much of the nation's population increment is concentrating in metropolitan areas, careful attention to the performance of those in the Region is warranted. Compared to the Region's total population growth of 2.9 percent, its metropolitan areas grew by 2.2 percent. However, there was considerable departure from this average metropolitan growth rate in the various state portions that contains SMSA counties (Table 2).

In relative terms, the range is from a loss of about 3 percent in West Virginia's SMSA counties to a gain of over 18 percent in Georgia's. The pattern of relative gains and losses is also interesting. Either losses or relatively small percentage gains typify Appalachian Ohio, Pennsylvania, and West Virginia with their older manufacturing cities. The growth performance is relatively better (though still below the national rate, except in Georgia) in Appalachian Alabama, Georgia, and North Carolina, with their more recent trends to manufacturing. Overall, there is tendency for

Table 2. **Population growth of Appalachia's SMSA counties, 1960-1966**

SMSA counties	Change in population numbers	Percent change in population
Alabama	103,881	9.3
Georgia	15,996	18.0
Kentucky	1,037	2.0
New York	14,737	5.7
North Carolina	35,594	11.8
Ohio	9,467	3.0
Pennsylvania	−54,142	−1.5
South Carolina	14,994	5.9
Tennessee	32,315	5.5
West Virginia	−18,335	−3.2
Appalachia	158,041	2.2
United States	15,885,832	13.3

metropolitanization to be relatively more effective in the southern part of the Region.

In absolute terms, the picture is generally the same but changes in emphasis arise because of the varying population sizes of the metropolitan areas of the states. The actual numerical changes are also shown in Table 2.

Though not the leader in relative growth, Alabama's Appalachian SMSA counties accounted for 66 percent of the Region's total SMSA increment. Adding North Carolina's increase to Alabama's accounts for 88 percent of the total net change. The absolute declines in Pennsylvania and West Virginia only serve to reinforce further the conclusion that Appalachia's metropolitanization is not only behind the national pace but is largely confined to Southern Appalachia.

Turning to the other extreme of the urban hierarchy, the rural and minor urbanized counties of Appalachia grew by 134,000. They accounted for 25 percent of the Region's population growth and added 2.8 percent to their own population.[2] On the national scene, these same categories of counties lost 211,000 people. (In other words, outside Appalachia, counties in these categories lost a total of 345,000 people.) Again, it is instructive to look at the Regional distribution of the absolute and relative gains (Table 3).

Compared with the United States, in relative terms, only West Virginia noticeably follows the pattern and, in that case, it is a reflection of a relatively large overall population decline. Of that state's total loss of 51,000, almost half occurred in counties whose urban population was between 2,500 and 10,000. The southern states of Georgia and North Carolina lead the relative growth ranking, but the pattern is mixed. Ohio and Maryland follow in rank order, and no clear north-south pattern exists.

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[2] Rural counties grew by 2.2 percent; minor urban counties by 3.2 percent.

In absolute terms the picture is far clearer and the southern propensity for growth even more apparent. Of the net population growth in these counties of 134,163 for the entire Region, 116,380 was in the four southern states of Alabama, Georgia, North Carolina, and Tennessee (Table 3).

Table 3. Population Growth of Appalachia's rural and minor urban counties, 1960–1966

Rural and minor urban counties	Change in population numbers	Percent change in population
Alabama	20,813	5.6
Georgia	41,824	11.6
Kentucky	— 886	−0.1
Maryland	1,580	7.7
Mississippi	11,476	4.5
New York	9,679	6.7
North Carolina	32,021	7.8
Ohio	2,235	0.8
Pennsylvania	12,121	3.6
South Carolina	896	2.2
Tennessee	31,722	5.6
Virginia	2,651	1.0
West Virginia	— 29,940	−3.6
Appalachia	134,163	2.9
United States	−211,317	−0.8

Over 45 percent of the total Appalachian growth occurred in non-metropolitan counties whose urban populations totaled between 10,000 to over 50,000. On a national basis, these counties accounted for less than 11 percent of the growth. In Appalachia, more than half the growth in these counties (i.e., one-quarter of the regional total) took place in counties with between 10,000 and 25,000 urban. For the entire country, more than half the growth in these counties (about 5 percent of the total) took place in counties with between 25,000 and 50,000 urban. The relatively greater dominance of the less urbanized counties in Appalachia's growth is apparent.

The basic pattern of greater southern growth is also revealed. Of the net growth of 28,705 in the entire Region of class 4 counties' population, 34,353 of the pluses were in South Carolina and Tennessee; of the 132,899 net growth in the entire Region in class 2 counties' population, Alabama, Georgia, Mississippi, North Carolina, and Tennessee accounted for 102,888. There are surprises, however. In the class 2 counties, those in Ohio grew by 21,607 or 7.0 percent, a performance that would not be expected on the basis of either the national or regional pattern. An even greater surprise is in the distribution of the net growth of 84,012 in counties with a total urban population of 25,000 to 50,000. Though Alabama accounted for a net growth of 29,623 (which could have been expected), New York and Pennsylvania each experienced growth of over 16,000 in counties of this urban size class.

It is now time to take one more look at Appalachia's net outmigration of 606,000. Pennsylvania and West Virginia account for 393,000. Kentucky provided 76,000 and Ohio and Virginia provided another 58,000. Again a basic north-south pattern appears. With about 40 percent of its population, the Region's metropolitan counties contributed almost half of the outmigrants. With below a quarter of the Regional population, rural and minor urban areas contributed more than proportionately to the exodus. Though they too exported population, the moderately urban counties did relatively better.

The pattern of population growth that emerges can be summarized as follows:

1. Appalachia is growing less rapidly than the United States.
2. Appalachia's metropolitan areas are growing less rapidly than those of the rest of the country.
3. All other types of counties in the Region are growing more rapidly than their national counterparts.
4. By and large, in all classes of counties the southern part of the Region has had a better recent population record than the northern part.
5. Close to half of the Region's total growth has been in moderately urbanized counties.
6. These moderately urbanized counties are virtually the only ones showing growth in the northern part of the Region.

Implications for Policy

Within the rural-urban policy discussions of the last few years, there have been speculations about two separate but related subjects: (1) whether there exists within our economic society an acceptable alternative to metropolitanization, and (2) whether it is possible to deliver efficiently the range and quality of public and private services to rural people that more urban citizens receive The Appalachian data and experience are relevant to each of these.

A look at the income data in Appendix Table 2, along with the population change experience just described, provides some interesting insights. At least in one relatively depressed region, non-metropolitan but urban counties are showing relative vitality of population growth. Perhaps Appalachia's present pattern of urbanization is a way-station to metropolitanization, but it is also possible that we may be seeing a viable alternative pattern emerging in an area that was not metropolitanized in the years when technology and markets first seemed to require it. A first glance at the income data tends to deny this possibility, however. In every Appalachia state, the declining size classes of counties ranked by urban population are matched by declining per capita income with three exceptions—one reversal each in Pennsylvania and South Carolina and two in Tennessee. This is a pattern we would expect on the basis of national observation, and it suggests that the Region's metropolitan areas may be the final destination of a population in transition from rural life. As economists, we typically assume that income differentials are something of a predictor of the direction of movement and, assuredly, in Appalachia per capita incomes are higher the greater the degree of urbanization.

However, there is another way to measure income differences that may be more meaningful, i.e., the amount of absolute gain in per capita income. By and large, incomes have been growing least in dollar amount at the less urban end of the spectrum; most at the moderately urban center of the spectrum; and by lesser amounts (but more than at the less urban end) at the metropolitan end of the scale. There are exceptions—Kentucky (a unique case because of the absence of any major urban center but with a metropolitan county), New York, North Carolina, Pennsylvania, and South Carolina—so many in fact that confidence in any generalization must be limited. But there does seem to be a mild tendency for moderately urban counties to provide larger per capita income increases. To the extent this is true, and to the extent that migration is absolute income-gain oriented rather than absolute income-level oriented, these moderately urban areas have a persistent, promising prospect.

Not the same can be said for the minor urban and rural counties. Their relatively low absolute income levels and low absolute amounts of income gain, combined with their historical outmigration pattern, do not permit viewing them in a similarly auspicious light. Despite garnering one-fourth of the Region's population gain in the 1960 to 1966 period, when income level and income gain considerations are added, their prospects are much dimmer.

Though the data are limited and somewhat ambiguous, Appalachia may be evolving a residence pattern that is urban but not metropolitan. Absolute income differences between metropolitan and moderately urban counties are declining, particularly where local urban population is over 25,000. Should the population and income data continue to be favorable, the Region could be a demonstration that an acceptable alternative to metropolitanization exists in at least part of the country.

The Appalachian experience also has some relevance for the questions about the efficient delivery of services. Experience shows that a policy of urban location of public facilities permits service to a rural population.

The Region's growth areas, the focus of investments, contain 12 percent of its area but 80 percent of its people.

There are actually two aspects to these questions concerning efficient service delivery: (1) reaching a sufficient scale of operation to be economical, and (2) providing adequate access by rural residents to the services. Both must be satisfied simultaneously. Adequate access to an urban center by a large rural population is the key that frequently is required for efficient operation of a diversity of services in that center. It is for this reason that the Commission has placed such emphasis on rural-urban linkages. It is commonly held that these are needed to provide services to the rural population and an adequate labor supply to the urban center. This is true, but equally true, they are frequently also needed to achieve economies of scale in the operation of facilities that are unattainable on the basis of the urban population alone. In the provision of efficient public services, particularly in health and education, the urban and rural parts of a growth area are dependent upon each other.

Mention has already been made of the fact that the Appalachian development program has two goals: the first emphasizes areas' economic competitiveness; the second, the ability of people to contribute and participate. The essence of a successful strategy is to serve these dual goals and, when they compete, to establish a priority between them. In the Appalachia program, the basic strategy is to enhance the competitive attractiveness of areas by augmenting their infrastructure, including those investments needed to deliver services directly to the population. Thus, area and personal opportunities are both served. However, if needed services to the population cannot be delivered from areas with significant economic growth potentials, service to the people takes precedence over areal upgrading.

The result is a hierarchy of areas in which investments are made. At one level, only those investments that are the sources of population-serving public activities are made, since the people concerned need improved prospects for economically successful out-commutation and outmigration. At other levels, area economic potential exists and appropriately scaled infrastructure investments for these purposes are also made.

Some have argued forcefully that the Regional Commission has established too many growth areas, and it has been argued that mobility and migration are the real solution to the Region's poverty. Added to these have been contentions that investment in people, not in economic development infrastructure, is the appropriate policy pattern. There may well be some truth to all of these contentions. However, policy realistically has to be a blend of assisting people to be capable of productive contributions and of assisting local areas and states to fulfill their potential economic role. If both of these can be served by growth areas that are moderately urban, accessible to a large majority of the population, and that can ultimately provide a wide range of public services efficiently, then the prospects for Appalachia and national urban policy are encouraging.

References

[1] Appalachian Regional Commission, *Policies for Appalachian Planning*, Washington, D.C., Sept. 1966.

[2] *Appalachian Regional Development Act of 1965*, Public Law 89-4, 89th Congress, March 1965.

Appendix Table 1. Comparative population and income data, United States, Appalachia, and Appalachian portion of states

	Population Estimate 1966 (number)	Population Change 1960-1966 (percent)	Net Migration (number) 1960-1966	Per Capita Personal Income 1959 (dollars)	Per Capita Personal Income 1966 (dollars)	Change In Per Cap. Income 1959-66 (percent)	Index of Per Capita Income 1959 (U.S. = 100)	Index of Per Capita Income 1966 (U.S. = 100)
United States	196,920,000	9.8	——	2,161	2,963	37.1	100	100
Appalachia	18,246,400	3.0	—606,100	1,661	2,297	38.3	77	78
Appalachian Portion of								
Alabama	2,160,000	9.0	15,100	1,578	2,169	37.9	73	73
Georgia	757,700	12.3	22,900	1,244	1,857	49.3	58	63
Kentucky	924,400	0.2	— 76,500	924	1,378	49.1	43	47
Maryland	209,700	7.1	2,600	2,115	3,136	48.3	98	106
Mississippi	432,700	6.5	— 8,300	1,025	1,590	55.1	47	54
New York	1,060,100	6.0	— 3,600	2,046	2,503	22.3	95	84
North Carolina	1,029,200	9.5	16,600	1,524	2,205	44.7	71	74
Ohio	1,162,600	2.0	— 30,500	1,501	2,054	36.8	69	69
Pennsylvania	5,880,800	—0.8	—330,900	1,935	2,683	35.2	92	91
South Carolina	626,900	6.9	— 11,800	1,575	2,487	57.9	73	84
Tennessee	1,716,400	6.8	— 12,000	1,485	2,188	47.8	69	74
Virginia	504,700	0.9	— 27,600	1,080	1,638	51.7	50	55
West Virginia	1,809,200	—2.8	—142,300	1,613	2,210	37.0	75	75

Sources: Population, U.S. Department of Commerce, Bureau of the Census
Income, U.S. Department of Commerce, Office of Business Economics

Appendix Table 2. Population and income by level of urbanization for selected years United States, Appalachia, and Appalachian portion of states

Urban Size Class No.	Classification of Counties by Total Urban Population 1960 Census	Population Estimate 1966 (number)	Population Change 1960-1966 (number)	Distribution of Population in 1960 (percent)	Distribution of Population in 1966 (percent)	Share of Population Change 1960-1966 (percent)	Net Migration (number)	Per Capita Personal Income 1959 (dollars)	Per Capita Personal Income 1966 (dollars)	Increase In Per Cap. Income 1959-1966 (dollars)
United States *										
5	Metropolitan (SMSA)	135,289,512	16,855,882	66.7	68.8	90.5	—	2,473	3,314	814
4	Urban Pop. over 50,000	7,019,151	633,207	3.5	3.6	3.9	—			
3	Urban Pop. 25,000-50,000	13,256,599	851,810	6.9	6.7	5.4	—			
2	Urban Pop. 10,000-25,000	15,143,016	249,467	8.8	7.7	1.4	—	1,573	2,226	653
1	Urban Pop. 2,500-10,000	17,624,881	—253,264	9.9	9.0	—0.8	—			
0	Rural	8,811,760	— 78,053	4.7	4.2	—0.4	—			
	TOTAL	196,655,000	17,639,900	100.0	100.0	100.0	—	2,161	2,963	802
Appalachia										
5	Metropolitan (SMSA)	7,472,700	178,341	41.3	41.9	29.4	—295,500	2,208	2,843	635
4	Urban Pop. over 50,000	1,612,800	38,705	8.9	8.8	6.3	— 58,400	1,746	2,449	703
3	Urban Pop. 25,000-50,000	1,766,400	94,312	9.6	9.7	15.6	— 28,200	1,742	2,486	744
2	Urban Pop. 10,000-25,000	2,676,200	152,399	14.4	14.7	24.7	— 42,700	1,393 **	2,034 **	641 ***
1	Urban Pop. 2,500-10,000	3,045,100	105,390	16.6	16.7	17.9	—125,800	1,131	1,643	512
0	Rural	1,691,200	43,167	9.3	9.2	7.1	— 59,500	858	1,268	410
	TOTAL	18,264,400	607,320	100.0	100.0	100.0	—610,100	1,661	2,297	636
Alabama										
5	Metropolitan (SMSA)	1,215,500	103,181	56.1	56.3	58.4	16,300	1,839	2,485	646
4	Urban Pop. over 50,000	100,800	5,122	4.8	4.3	2.8	—3,600	1,626	2,288	662
3	Urban Pop. 25,000-50,000	268,700	29,628	11.8	12.2	16.7	7,100	1,439	2,192	753
2	Urban Pop. 10,000-25,000	184,900	18,475	8.4	8.7	10.4	5,400	1,128	1,702	574
1	Urban Pop. 2,500-10,000	284,000	13,132	13.7	13.1	7.4	—4,400	920	1,392	472
0	Rural	111,100	7,631	5.2	5.1	4.3	800	815	1,179	364
	TOTAL	2,160,000	177,714	100.0	100.0	100.0	11,100	1,573	2,169	596
Georgia										
5	Metropolitan (SMSA)	104,800	16,536	13.2	13.	19.3	6,700	1,336	1,661	325
4	Urban Pop. over 50,000	—	—	—	—	—	—	—	—	—
3	Urban Pop. 25,000-50,000	72,100	7,370	10.2	9.	8.6	—2,600	1,675	2,548	873
2	Urban Pop. 10,000-25,000	178,200	22,838	23.2	23.	26.5	5,600	1,475	2,234	758
1	Urban Pop. 2,500-10,000	234,800	27,094	30.9	31.	31.5	8,500	1,181	1,828	647
0	Rural	167,800	16,760	22.5	22.	19.1	3,700	874	1,301	427
	TOTAL	757,700	85,676	100.0	100.	100.0	22,900	1,244	1,857	613
Kentucky										
5	Metropolitan (SMSA)	63,200	1,027	5.7	5.8	46.1	— 2,900	2,080	3,365	1,285
4	Urban Pop. over 50,000	—	—	—	—	—	—	—	—	—
3	Urban Pop. 25,000-50,000	—	—	—	—	—	—	—	—	—
2	Urban Pop. 10,000-25,000	177,500	2,097	19.0	19.1	93.3	—11,500	1,068	1,570	502
1	Urban Pop. 2,500-10,000	363,200	89	39.4	39.3	4.0	—31,700	874	1,273	399
0	Rural	330,500	—973	35.9	35.7	—43.4	—30,400	688	1,066	378
	TOTAL	924,400	2,243	100.0	100.0	100.0	—76,500	924	1,378	454
Maryland										
5	Metropolitan (SMSA)	—	—	—	—	—	—	—	—	—
4	Urban Pop. over 50,000	—	—	—	—	—	—	—	—	—
3	Urban Pop. 25,000-50,000	187,700	12,312	89.6	89.5	88.6	2,400	2,208	3,266	1,058
2	Urban Pop. 10,000-25,000	—	—	—	—	—	—	—	—	—
1	Urban Pop. 2,500-10,000	—	—	—	—	—	—	—	—	—
0	Rural	22,000	1,584	10.4	10.5	11.4	100	1,084	1,808	724
	TOTAL	209,700	13,896	100.0	100.0	100.0	2,500	2,115	3,136	1,021
Mississippi										
5	Metropolitan (SMSA)	—	—	—	—	—	—	—	—	—
4	Urban Pop. over 50,000	—	—	—	—	—	—	—	—	—
3	Urban Pop. 25,000-50,000	—	—	—	—	—	—	—	—	—
2	Urban Pop. 10,000-25,000	161,500	15,287	36.1	37.3	56.7	700	1,297	2,013	716
1	Urban Pop. 2,500-10,000	164,600	6,706	38.8	38.1	25.1	—7,100	908	1,473	565
0	Rural	106,600	4,570	25.1	24.6	17.2	—1,900	739	1,184	445
	TOTAL	432,700	26,618	100.0	100.0	100.0	—8,300	1,025	1,590	565

* *The U.S. population total and distribution does not include Alaska. The national income figures, however, do include the State.*

** *The per capita income for the five non-metropolitan groups was $1,217 in 1959 and $1,688 in 1966.*

*** *The increase in per capita income for the five groups was $471.*

(Appendix Table 2 continued)

Urban Size Class No.	Classification of Counties by Total Urban Population 1960 Census	Population Estimate 1966 (number)	1960-1966 Population Change (number)	Distribution of Population in 1960 (percent)	Distribution of Population in 1966 (percent)	Share of Population Change 1960-1966 (percent)	Net Migration (number)	Per Capita Personal Income 1959 (dollars)	Per Capita Personal Income 1966 (dollars)	Increase In Per Cap. Income 1959-1966 (dollars)
New York										
5	Metropolitan (SMSA)	265,200	14,737	25.1	25.0	24.6	—5,500	2,254	3,027	773
4	Urban Pop. over 50,000	255,000	10,917	24.4	24.1	18.2	—2,400	2,198	2,860	662
3	Urban Pop. 25,000-50,000	260,800	16,758	24.4	24.6	27.9	300	1,965	2,795	830
2	Urban Pop. 10,000-25,000	101,000	7,945	9.3	9.5	13.2	3,300	1,771	2,321	550
1	Urban Pop. 2,500-10,000	178,100	9,679	16.8	16.8	16.1	800	1,713	2,322	609
0	Rural	—	—	—	—	—	—	—	—	—
	TOTAL	1,060,100	60,036	100.0	100.0	100.0	—3,500	2,046	2,503	457
North Carolina										
5	Metropolitan (SMSA)	377,900	35,594	36.4	36.7	39.8	8,600	1,965	2,789	824
4	Urban Pop. over 50,000	—	—	—	—	—	—	—	—	—
3	Urban Pop. 25,000-50,000	—	—	—	—	—	—	—	—	—
2	Urban Pop. 10,000-25,000	208,900	21,845	19.9	20.3	24.4	6,000	1,414	2,097	683
1	Urban Pop. 2,500-10,000	227,500	23,314	21.7	22.1	26.1	6,600	1,335	1,985	650
0	Rural	214,900	8,707	22.0	20.9	9.7	—4,400	929	1,454	525
	TOTAL	1,029,200	89,460	100.0	100.0	100.0	16,800	1,524	2,205	681
Ohio										
5	Metropolitan (SMSA)	328,500	9,467	28.5	28.5	27.0	— 9,800	1,579	2,120	541
4	Urban Pop. over 50,000	—	—	—	—	—	—	—	—	—
3	Urban Pop. 25,000-50,000	214,900	1,736	21.5	21.0	5.0	—12,000	1,711	2,329	618
2	Urban Pop. 10,000-25,000	309,400	21,607	25.7	26.8	61.7	2,200	1,517	2,144	627
1	Urban Pop. 2,500-10,000	218,100	1,520	19.4	18.9	4.3	—10,700	1,175	1,605	430
0	Rural	54,700	715	4.8	4.8	2.0	— 1,200	1,210	1,527	317
	TOTAL	1,152,600	35,045	100.0	100.0	100.0	—30,500	1,501	2,054	553
Pennsylvania										
5	Metropolitan (SMSA)	3,661,200	—54,142	62.6	62.3	—108.3	—227,900	2,197	3,008	811
4	Urban Pop. over 50,000	772,800	—23,556	13.4	13.1	— 47.1	— 53,100	1,613	2,175	562
3	Urban Pop. 25,000-50,000	405,600	16,241	6.6	6.9	32.5	— 6,200	1,715	2,425	647
2	Urban Pop. 10,000-25,000	689,400	— 648	11.6	11.7	— 1.3	— 38,400	1,537	2,170	633
1	Urban Pop. 2,500-10,000	286,000	9,499	4.7	4.9	19.0	— 5,200	1,476	1,958	482
0	Rural	65,800	2,622	1.1	1.1	5.2	— 100	1,329	1,773	444
	TOTAL	5,880,800	—49,984	100.0	100.0	—100.0	—330,900	1,985	2,683	698
South Carolina										
5	Metropolitan (SMSA)	270,800	14,994	43.6	43.2	37.1	—11,300	1,675	2,804	1,129
4	Urban Pop. over 50,000	276,500	21,192	43.5	44.1	52.5	400	1,555	2,367	812
3	Urban Pop. 25,000-50,000	—	—	—	—	—	—	—	—	—
2	Urban Pop. 10,000-25,000	38,500	3,295	6.0	6.1	8.2	200	1,124	1,670	546
1	Urban Pop. 2,500-10,000	41,100	896	6.9	6.6	2.2	— 1,100	1,207	2,061	854
0	Rural	—	—	—	—	—	—	—	—	—
	TOTAL	626,900	40,377	100.0	100.0	100.0	—11,800	1,575	2,487	912
Tennessee										
5	Metropolitan (SMSA)	638,800	32,815	37.7	37.2	30.2	—12,700	1,966	2,796	830
4	Urban Pop. over 50,000	127,300	13,161	7.1	7.4	12.1	3,300	2,063	3,273	1,210
3	Urban Pop. 25,000-50,000	70,200	5,268	4.0	4.1	5.0	800	1,409	1,997	588
2	Urban Pop. 10,000-25,000	282,200	25,645	16.0	16.4	23.6	5,500	1,299	2,034	735
1	Urban Pop. 2,500-10,000	380,500	26,669	22.0	22.2	24.5	800	954	1,477	523
0	Rural	217,400	5,053	13.2	12.7	4.6	— 9,700	796	1,151	355
	TOTAL	1,716,400	108,711	100.0	100.0	100.0	—12,000	1,485	2,188	703
Virginia										
5	Metropolitan (SMSA)	—	—	—	—	—	—	—	—	—
4	Urban Pop. over 50,000	—	—	—	—	—	—	—	—	—
3	Urban Pop. 25,000-50,000	—	—	—	—	—	—	—	—	—
2	Urban Pop. 10,000-25,000	237,100	1,722	47.0	47.0	39.5	—13,900	1,262	1,917	655
1	Urban Pop. 2,500-10,000	87,700	2,694	17.0	17.4	61.2	— 1,700	967	1,707	740
0	Rural	179,900	— 33	36.0	35.6	— 0.7	—12,000	846	1,200	354
	TOTAL	504,700	4,383	100.0	100.0	100.0	—27,600	1,080	1,638	558
West Virginia										
5	Metropolitan (SMSA)	556,800	—18,335	30.9	30.8	— 35.8	— 55,000	2,941	3,159	218
4	Urban Pop. over 50,000	80,400	2,067	4.2	4.4	4.0	— 4,000	2,038	2,948	910
3	Urban Pop. 25,000-50,000	264,400	— 996	14.3	14.6	— 1.9	— 13,000	1,606	2,274	668
2	Urban Pop. 10,000-25,000	107,600	— 4,017	6.0	6.0	— 7.8	— 9,800	1,343	1,885	542
1	Urban Pop. 2,500-10,000	578,800	—25,206	32.5	32.0	— 49.2	— 63,700	1,137	1,558	421
0	Rural	221,200	— 4,734	12.1	12.2	— 9.3	— 16,800	948	1,345	397
	TOTAL	1,809,200	—51,221	100.0	100.0	—100.0	—162,300	1,613	2,210	597

Sources: Population, U.S. Department of Commerce, Bureau of the Census.
Income, U.S. Department of Commerce, Office of Business Economics.

VIGNETTES: TOOLS OF OUR TRADE

CHAIRMAN: ALEXANDER F. MCCALLA, UNIVERSITY OF CALIFORNIA, DAVIS

Marketing, Price, and the Theory of Communication

WAYNE D. PURCELL

PRICE is charged with the task of coordinating economic activity along the vertical continuum between producer and consumer. Activities at the various levels are related in a technical sense. How the technical interrelationships are handled operationally depends upon decisions by entrepreneurs at the various levels. These decisions are a function of the output of the prevailing communication system. Mounting evidence suggests the price system is incapable of functioning as an effective system of communication [4]. I contend that (1) the marketing economist must broaden his perspective to include analysis of the barriers to effective communication, whatever the origin of those barriers; and (2) the developing theory of communication can provide the tools needed to make such a reorientation of our research efforts productive.

On Communication Theory

Space limitations preclude a treatise on the theory of communication. Several references are cited [1, 2, 7]. I have developed elsewhere more complete treatments of the theory and how it can be employed in analyzing problems of inefficiency in marketing [4, 5, 6]. Only a brief discussion is possible here.

The basic process in communication involves the construction of a message by a *source* and the transmission of that message along some *channel* to a *receiver.* Feedback loops typically extend from the receiver back to the source, providing the basic mechanism for adjustment. The process of communication can become very complex. Actions of each party to the process are affected by the operating environment, by perception of role, by the level of training, and many other factors. Communication processes are continuous, dynamic, and always subject to pressures for change. Roles are reversible as the receiver acts as a source and vice versa—especially when time is a variable.

The communication theorist is interested in the necessary and sufficient conditions for effective communication. Since the theory of communication was born in the Shannon-Weaver work in 1949, development has

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been rapid and continuous [7]. Much of the research has been directed toward empirical verification of the relevance and relative importance of requisites to effective communication, which emerged from theoretical constructs.

Marketing as a System of Communication

Marketing is a communication process. The notion of pricing efficiency has long been used as a proxy for communication in discussing the extent to which our marketing systems succeed in their assigned task of coordination. What I am proposing is an approach to analysis that *emphasizes* the processes of communication inherent in any marketing system. A particular marketing system can be evaluated in terms of its relative effectiveness or ineffectiveness, as a communication system. Obstacles to effective communication are isolated and analyzed by employing the theory of communication and the requisites of effective communication processes as a standard. Possible corrective measures can then be drawn from the theory or formulated as hypotheses for further investigation.

The beef marketing system

In a study of the beef marketing system, a number of obstacles to effective communication were isolated.[1] Three of the more important will be discussed briefly.

One of the most important obstacles evolves from the continued use of clearly inadequate descriptive terminology. A fundamental requisite of effective communication is a descriptive terminology that requires a minimum of interpretation by the receiver. *Meanings are in the message users, not the message per se.* Differences in attachment of meaning is minimized by using a terminology that exhausts all significant categories within the normal range of variability. But researchers have found value differentials that exceed $100 between choice grade carcasses of comparable weights. How effective can the proverbial price signal be as a medium of communication under such conditions?[2] What we have called "pricing efficiency" is not being realized because price-related requisites of effective communication are not being met.

A second obstacle emerges from what I have labeled variable conditions of exchange. If communication efforts are to be effective, each party to the process must be cognizant of pertinent characteristics of the setting within which the interchange takes place. This requirement has been consistently violated in the beef marketing system.

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[1] The study was conducted during 1965–1967 under a cooperative arrangement between Michigan State University and ERS, USDA.

[2] In a recent paper, Stout [8] reports "live price error" in cattle (actual live price compared with a derived live price based on retail values of the carcass) to range from —$3.36 to $3.78 per hundredweight.

To illustrate, consider the procedure that was typical in carcass grade and weight sales of slaughter beef prior to the regulatory action by Packer and Stockyards Administraton in the spring of 1968. Price was negotiated by weight and grade groupings, with the packer taking a "pencil shrink" to compensate for weight loss during chilling of the carcass. Under such an arrangement, "real price" can differ from negotiated price if pencil shrink differs from actual shrink.[3] A survey by USDA estimates that shrink for an overnight chill ranges from .5 to 1.5 percent [3]. But a 1967 Oklahoma survey revealed that 3.0 percent had developed as a standard pencil shrink. Oklahoma cattle feeders were taking pencil shrinks considerably above 1.25 percent (adopted as an arbitrary norm in the study) with resulting price distortions (absolute differences between negotiated price and real price) ranging in excess of $1.00 per hundredweight [9].

A third obstacle, a bit more abstract but very important, is the narrow perspectives adopted by system participants. Individualistic operating policies, perhaps inconsistent with policies that would facilitate superior system performance, are not unexpected. Such inconsistencies do prevail but are not the result of conscious weighing of individual desires against requirements for a viable and efficient marketing system. Many entrepreneurs simply do not perceive of their operation as part of a system.

Effective communication requires that all parties to the communication process understand how they relate to other participants in the system. We can only speculate as to how performance of the beef marketing system would change if each participant better understood his role as part of the total system. Recognizing the possibility of conflicts of interests, do we know whether it would be mutually beneficial if the degree of coordination between certain separately controlled activities were increased? A complete systems approach, encouraged by emphasis on the communication system, is needed to help remove the roadblocks to progressive adjustment which accompany narrow perspectives and completely individualistic operating policies.

A Final Observation

More work is needed to establish the potential of a research orientation that emphasizes the communication processes inherent in marketing activities. Such an orientation does decrease the relative importance given to price and the price mechanism. Price is an important part of a more complex communication system, but only a part. In our beef marketing system, price falls short as a medium of communication because other requisites of effective communication are not met. Perhaps it is time for our research priorities to be adjusted, permitting more attention to be paid the obstacles to effective communication and how these obstacles affect performance of marketing systems.

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[3] Real price refers to the price derived by dividing carcass value, based on negotiated price and pencil shrink, by the actual weight of the chilled carcass. For example, real price on a 600-pound carcass (hot weight) with a negotiated price of $45.00, a pencil shrink of 3.0 percent, and an actual shrink of 1.5 percent would be $44 31 per hundredweight.

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Concentration in Farming and Transition Bias

RONALD L. MIGHELL

NO fact about farming is better known than the continuing trend toward fewer and larger commercial farms. Less is known about changes in relative concentration of farming in different size groups. Are large farms growing faster than small farms? For evidence, observers usually turn to the convenient census economic classes (Tables 1 and 2). A first impression from such information is that increasing concentration is indeed taking place in the upper size classes.

But frequency distributions of this kind are not designed to measure changes in relative concentration in a growth situation. They are subject to a serious limitation, which may be termed transition bias. The purpose of this paper is to call attention to this limitation and to suggest what can be done about it.

Transition Bias

Transition bias arises from the passage, or transition, of numbers from lower to higher classes as growth takes place. The result is that comparisons between numbers in the same size class in two periods do not indicate relative changes for those that occupied the size class in the first period.

Suppose we consider an oversimplified example. A stand of trees is set out at the rate of 100 trees a year until 1,200 trees are planted. At the end of 12 years and 15 years, the age distributions are as follows:

Age class	Year 12	Year 15
Years	*Number*	
0–6	600	300
7 and over	600	900
Total	1,200	1,200

The numbers have decreased in the lower age group and increased in the upper one. Does this mean that aging has been more rapid in the upper age group? No, because the whole distribution is aging at the same rate. The distribution of the age classes about the rising average age is exactly the same in each year. The increase in the upper age class is due

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Table 1. Number of commercial farms by specified size groups, and percentage of total, United States, 1959 and 1964

Size in value of sales	Number		Percentage of total	
	1959	1964	1959	1964
dollars	*thousands*		*percent*	
100,000 or more	20	31	0.8	1.6
40,000–99,999	82	110	3.4	5.5
20,000–39,999	210	260	8.7	13.0
10,000–19,999	483	467	20.0	23.3
5,000– 9,999	654	505	27.1	25.2
2,500– 4,999	618	444	25.6	22.2
Less than 2,500	349	184[a]	14.4	9.2
All commercial farms	2,416	2,001[a]	100.0	100.0

[a] Adjusted to 1959 Census definition of commercial farms.

Table 2. Total values of sales from commercial farms by specified size groups, and percentage of total, United States, 1959 and 1964

Size in value of sales	Total value of sales		Percentage of total	
	1959	1964	1959	1964
dollars	*million dollars*		*percent*	
100,000 or more	4,981	8,539	16.9	25.0
40,000–99,999	4,671	6,474	15.8	18.9
20,000–39,999	5,648	7,114	19.2	20.8
10,000–19,999	6,705	6,614	22.8	19.3
5,000– 9,999	4,723	3,653	16.0	10.7
2,500– 4,999	2,274	1,611	7.7	4.7
Less than 2,500	461	192[a]	1.6	.6
All commercial farms	29,463	34,197[a]	100.0	100.0

[a] Adjusted to 1959 Census definition of commercial farms.

solely to the transition from the lower to the upper age class with the passage of time.

No one is likely to be trapped by this situation. But it is not so immediately obvious that the same kind of relationship may bias comparisons that involve economic classes in two periods of time. One reason is that we often lack other background information. Another is that there are a number of legitimate uses for such comparisons. For example, business firms supplying farmers or buying from them are interested in broad changes in numbers of farmers with certain dollar volumes of sales or purchases.

Transition Matrix Analysis

Preliminary graphic analysis of the data in Table 1 suggested that the relative reduction in farm numbers was about the same in all sales classes between 1959 and 1964. Similarly, the relative increase in sales per farm in all 1959 sales classes seemed nearly the same. This was tested by setting up the transition matrix shown in Table 3. Here it was assumed that the number of farms in each class decreased 17 percent from 1959 to 1964 (the average decrease in numbers of commercial farms). These decreases appear in the 0, or absorbing column. Then, beginning with the lowest class, enough farms were permitted to rise to the next higher class to balance out to the numbers shown in the 1964 distribution.

The farms that moved up to the next higher class represented the following percentages of the numbers in the 1959 class from which they came:

Moved up to next higher class from	Percent
$40,000–,99,999	18.3
20,000– 39,999	27.6
10,000– 19,999	29.8
5,000– 9,999	32.3
2,500– 4,999	28.0
Less than 2,500	30.1

These percentages are close to one another except for the 18.3 in the highest class. Such results lend support to the belief that, in terms of broad group tendencies, the effects of technology are widely spread through all the size classes of commercial farms.

Lorenz Curves

So far the discussion has centered on farm numbers. A method of taking account of both relative changes in number of farms and in value of sales is to use Lorenz curves. A Lorenz curve shows the cumulative percentage of farms on the horizontal scale and the cumulative percentage of sales of farm products on the vertical scale. Such curves can be approximated from the census data by economic classes. Then, by interpolation, readings can be made for corresponding percentage sectors for each year.

Such curves were prepared for 1959 and 1964 and the data in Table 4 read from them. These data indicate that percentage distributions in the two years were much alike, but with a tendency for a slight increase in sales in the highest two percentiles. Note that the increase shown in much less than that suggested in Table 2.

Table 3. Transition matrix showing shifts in number of commercial farms from 1959 to 1964

Sales class in 1959	Number in 1959	Number of farms in 1964								
		Value of sales class								
		0	$100,000 or more	$40,000 to $99,999	$20,000 to $39,999	$10,000 to $19,999	$5,000 to $9,999	$2,500 to $4,999	Less than $2,500	All farms 1964
dollars	*thousands*									
100,000 or more	20	4	16							
40,000–99,999	82	14	15	53						
20,000–39,999	210	36		58	116					
10,000–19,999	483	83			144	256				
5,000– 9,999	654	112				211	331			
2,500– 4,999	618	106					173	339		
Less than 2,500	349	60						105	184	
All farms 1959	2,416	415	31	111	260	467	504	444	184	2,001

Table 4. Percentage of total value of sales from commercial farms by specified sectors of the size distribution, United States, 1959 and 1964

Percentage sector of farm numbers	Percentage of total value of sales	
	1959	1964
Highest 10 percent	45.0	49.0
Second 10 percent	15.0	15.6
Second 20 percent	18.8	17.2
Third 20 percent	1[illegible].9	10.0
Fourth 20 percent	6.3	5.2
Lowest 20 percent	3.0	3.0
All commercial farms	100.0	100.0

Conclusions

The usual comparisons of economic class distributions of numbers of farms between two periods are affected by a transition bias, which seems to imply a faster rate of growth on the part of larger farms than is actually the case. When allowance is made for this bias, it appears that despite a considerable downward shift in numbers and an upward trend in size of farms the relative size distribution has not changed greatly. Lorenz curve analysis shows only a small tendency for an increase in sales in the highest percentiles.

Moreover, it is possible that the extra sales in the highest percentiles are offset by higher expenditures. Partial evidence about the kinds of farming involved and the kinds of expenditures and investment costs suggest this possibility.

A final word of caution should be noted. All of the discussion in this paper is in terms of national totals for commercial farms. Within these totals are many divergent and offsetting influences. Data for particular regions or types of farming may indicate quite different changes.

Computer Simulation of the Substitution Between Project Size and Management

S. F. MILLER AND A. N. HALTER

DURING the last several years, emphasis has been placed on comprehensive river basin planning and management. Many government agencies, both federal and state, have been established to perform this service. Traditionally, federal agencies have been single purpose or function oriented. However, with the issuance of Senate Document 97, comprehensive river basin planning has been stressed. This has enabled agency cooperation to develop general comprehensive plans for entire river basins, considering all beneficial uses of water.

Comprehensive planning of river basins is not easy. Basins that cover large geographical areas are complex systems containing many feedbacks and interactions that must be understood and quantified by the planning agency. Also, the water of a river basin can be used for a variety of purposes that are generally competitive in nature. Thus, in the situation where insufficient natural flow exists to satisfy all uses, the economic question occurs in selection among alternatives.

Alternative projects have traditionally been evaluated by means of benefit-cost analysis. Benefit-cost analysis, properly used, can be employed to determine the scale of development. But a misconception still prevailing in water resource circles is the belief that the size of the physical project is independent of project management. Even fellow economists have not applied the function of management in considering the proper size of a contemplated structure. For example, the expected flood control benefits of a project are calculated, "given the assumptions of constant flood probabilities, of reliable stage-damage relationships, and of correct operation of reservoirs" [1, p. 135].

In developing the project design, management of the project enters as a design variable in the form of the "rule curve." The curve specifies how full the reservoir is to be at any point in time during the hydrologic year. In developing the curve, consideration is given to the multiplicity of uses of the water and space of the storage facility and their relationship to the river basin system. Thus, during potential flood months the curve is low, while during the late spring and early summer it is high in an attempt to provide adequate water for irrigation, pollution abatement, recreation, etc. This, of course, does not mean that the reservoir will be at the speci-

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fied level of the rule curve at all times, but rather that the rule curve guides to allocate space between opposed uses. Thus, management (rule curve or operating procedure) and the size of the project interact.

Modifying the management policy may be economically more advantageous than modifying the size of the project. It is conceivable, of course, to construct a project so big that all possible beneficial uses are fulfilled, thereby simplifying the management. But it is doubtful that such a system would be within any realistic cost constraints. The more general situation is that proper consideration of management allows the size of the project to be diminished without reducing net benefits. The relationship theoretically could be visualized in the traditional iso-product context shown in Figure 1.

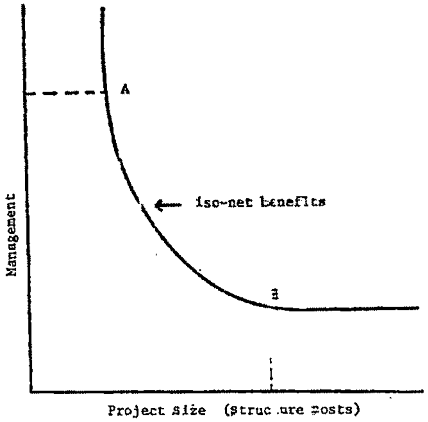

Figure 1. Substitutability between management and project size

We have shown an iso-net benefit curve which illustrates the possible substitution of management for project size. The diagram shows that an increase in management could reduce the size of project and still obtain the same net benefits. There exists a point, however, where management cannot continue to substitute for project size (point A) and a point where added size cannot substitute for management (point B). Although it is our hypothesis that equal net benefits can arise from different combinations of management and project size, the diagram implies that one can distinguish more management from less. This conceptual difficulty of the diagram should not detract from the idea of substitution; however, it does make it difficult if not impossible to empirically trace out either one iso-benefit curve or a family of curves for a response surface.

Objective

The objective of this study is to test the hypothesis that management can substitute for increased project size. To do so, a small river basin system was simulated on a digital computer and the effects of alternative structural sizes and management procedures evaluated in the form of accumulated net benefits.

Calapooia River Basin Simulation

The river basin selected to test our hypothesis was that of the Calapooia River located in the middle Willamette River Basin of western Oregon. In 1948 the Corps of Engineers proposed that a dam with an overall capacity of 97,000 acre-feet be constructed on the Calapooia at Holley, Oregon, and that the channel of the river be deepened below the dam. The project, however, was never funded. The Corps of Engineers has since initiated a re-study of the basin, consistent with Senate Document 97.

The simulation model that was developed for the Calapooia River Basin is discussed in detail elsewhere [2]. The major design variables were size of reservoir, size of channel, and operating rules. While the model is perfectly general in its consideration of structure sizes within its design range (0–97,000 acre-feet for the reservoir, and 5,000–21,000 cubic feet per second for the channel), we confined ourselves to investigating five alternative projects, shown in the first column of Table 1. These size structures were selected because the Corps of Engineers, at the time of this study, had estimated the use benefits and the structure cost that can be expected from these projects.

In order to evaluate the alternative projects, point-wise functions relating costs to reservoir and channel sizes were provided by the Corps of Engineers and incorporated into the model. The estimated benefit functions in dollars from the uses of water considered in this study were also provided by the Corps of Engineers. These included benefit functions for irrigation, flood control, drainage, and fish life.

As programmed into a model, the beneficial use potentials are functions

Table 1. Summary of simulation results

Project number	Capacity		Accumulated total annual costs	Accumulated net benefits		
	Reservoir	Channel		Unmodified	3 percent increase	6 percent increase
	acre feet	*cubic feet per second*	*thousand dollars*			
R97C21	97,000	21,000	114,584	33,277	49,689	49,697
R97C11	97,000	11,000	97,115	24,308	35,720	35,727
R97C5	97,000	5,000	87,083	8,623	16,157	16,165
R67C21	67,000	21,000	97,046	20,241	22,885	23,605
R67C5	67,000	5,000	69,545	−10,406	−7,833	−7,109

of the reservoir size, the channel size, or the operating procedure. Irrigation benefits are a positive function of storage capacity of the reservoir. As storage capacity increases, the irrigable acreage also increases. Flood control and fish benefits are dependent not only on reservoir size but also on channel size. Drainage, on the other hand, is related only to the size of the channel.

Results of Computer Runs

The computer model simulates the hydrology by a modified stochastic approach over a one hundred year period. Thus the benefits arising from a project are random variables with a distribution and mean. One hydrologic trace provides a single estimate of accumulated annual net benefits. Other estimates could be obtained by using different hydrologic traces; however, this was not done in this study A hundred year period was used for both the economic and physical life of the project because it was the period assumed by the Corps of Engineers For each modification in the model, the same hydrology is generated in order that the effects can be compared.

Using the suggested rule curve supplied by the Corps of Engineers, the accumulated net benefits in the "Unmodified" column of Table 1 were generated. It was noticed, however, that inadequate water during critical periods of the year limited the fish benefits. These periods generally occurred during the late summer and early fall as a result of the low natural flow in the channel. The low reservoir level, caused by the need for flood storage in the late spring and by releases for irrigation, precluded supplemental release for fish maintenance. It was therefore decided to test the consequence of a change in management by increasing the rule curve three percent over most of its range. A priori, one would expect a reduction in flood control benefits because less storage is available to capture flood waters but an increase in irrigation and fish benefits. As expected, fish benefits did increase for all projects. Irrigation benefits in the small reservoir projects also increased slightly. However, flood control benefits for all projects remained virtually unchanged. The resulting net increase in accumulated net benefits to all projects is given in Table 1.

Because of the increased accumulated net benefits, a further increase of the curve was tested. The rule curve was increased by an additional three percent, for a total of six percent. As seen in Table 1, virtually no change occurred in the accumulated net benefits, suggesting that further modification would not be beneficial.

Out of these three management policies, however, we are able to identify three points on the management-structure size isoquant if we assumed that the change in management policy constituted an increase in management. Project R97C21 with the unmodified rule curve yielded net benefits totaling $38,277,000. Project R97C11 with the rule curve increased by both three and six percent yielded approximately the same accumulated net benefits, $35,720,000 and $35,727,000, respectively. If size is measured in terms of the accumulated total annual costs, Project R97C21 costs $114,504,000 and Project R97C11 costs $97,115,000. Thus, the first and the second management level are somewhere in the substitution zone marked A-B on Figure 1. The second management level required less total cost but increased management. The third management level is above point A. Accumulated total annual costs are the same and management has increased. Conceptually, what has happened is that an increase in the rule curve (increase in management) has substituted for capital input. Of course, from an empirical standpoint, quantitative measures of rates of substitution are difficult if not impossible to measure because of the difficulty of placing management on a cardinal scale.

Conclusions

On the basis of these research results, the following conclusions appear warranted: (1) It is believed that management and project size are substitutes. Specifications of sources of substitutability provide a fertile field of inquiry for water resource researchers. (2) Proper management needs to be given greater consideration in project planning. (3) Computer simulation appears to be a promising approach to river-basin planning and development. It is capable of considering changes in project scale as well as changes in management procedures.

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An Economic Model for Determining Cotton Allotments and Prices to Maximize Net Farm Income*

Fred Sobering, Leroy Quance and Luther Tweeten

ECONOMISTS have long used linear programming as a tool in farm management and policy research. Research reported herein complements linear programming of representative farms with regression and marginal analysis to determine: (1) the impact of various cotton price-allotment combinations on net farm income (profit) and enterprise levels on well-organized farms in Southwestern Oklahoma[1]; (2) the national cotton price support and allotment levels maximizing farmers' net income, given the level of federal expenditures on the cotton program; and (3) the value of an acre of cotton allotment.

Cotton Production Response to Changes in Allotments

Changes in cotton production at specified levels of allotments and cotton prices are summarized in Table 1. The relationship between cotton allotments and cotton production is formalized in the elasticity E_{OA} of cotton output with respect to acreage allotment. It shows the percentage change in output corresponding to a one percent change in acreage allotments. Theoretically, we would expect a small elasticity at low cotton prices because cotton is unprofitable—it does not pay to expand output even though the allotment is increased. We would also expect an elasticity of less than one at high allotments because all land suitable for cotton is utilized, and further allotment increases are used either on poorer land or not at all.

Estimates in Table 1 confirm slippage in cotton allotments; for example, with a cotton price of $26.40 per hundredweight and with allotments from 100 to 115 percent of the 1963 base, each one percent decrease in allotment would reduce production only .92 percent in Southwest Oklahoma.

To check the realism of the computed elasticities, actual data on allotments and cotton output for Oklahoma and Texas for the years 1961 through 1964 were used to compute the output-allotment responses. From 1961 to 1964, allotments were reduced from 8 733,000 to 7,629,000 acres, or

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* A report on research conducted under Oklahoma Station Project 1040. For a more complete presentation of the findings of this research, see (1) Note: transferred to Reference on p. 1128

[1] "Well-organized" refers to the combination and level of enterprises that maximize net farm income.

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Table 1. **Cotton output, elasticity of output with respect to allotment level, and net farm income for various allotment and cotton price levels; dryland cotton, Southwestern Oklahoma**

Cotton price	Cotton allotment	Area aggregate		Net farm income[b]	
		Cotton output	E_{OA}[a]	Per farm	Area
dollars per hundred weight	*percent of 1963 base*	*thousand hundred-weight*		*dollars*	*thousand dollars*
30.80	115	1,330.9			
30.80	100	1,174.8	.893	8,859	38,988
30.80	85	1,014.6	.902	8,423	37,072
30.80	55	662.7	.979	7,431	32,703
26.40	115	1,331.0		7,962	35,042
26.40	100	1,170.8	.918	7,687	33,832
26.40	85	1,014.4	.883	7,409	32,607
26.40	55	662.7	.978	6,768	29,787
22.00	115	1,237.2		6,679	29,394
22.00	100	1,100.6	.838	6,549	28,822
22.00	85	960.5	.838	6,416	28,236
17.60	115	802.8		5,699	25,081
17.60	100	712.9	.850	5,669	24,949

[a] The elasticity of cotton output with respect to acreage allotment, showing the percentage decrease in cotton production associated with a one percent decrease in cotton allotment.

[b] Return to land, operator labor, and management.

12.64 percent. Output was reduced from 5,135,000 bales to 4,540,000 bales. For this time period, the actual E_{OA} was 0.91. This compared closely to the predicted values in Table 1. Similarly, the actual E_{OA} for the period 1962–1964, in which allotments were reduced 10.88 percent, was 0.88—very similar to the computed values for the aggregate area. However, the actual E_{OA} varied considerably from year to year. For example, for 1962 to 1963 it was .52; from 1963 to 1964, when allotments were decreased by a fraction of a percent, it was 7.049. Actual elasticities from consecutive years are greatly influenced by yield variations due to weather and factors other than the allotment level. Such variations make it extremely difficult to determine precisely the adjustment in allotment required to realize a desired goal of output reduction on a year-to-year basis. Over a longer period of time, the elasticity predicts outcomes with greater reliability, as indicated above, and a knowledge of E_{OA} is helpful in formulating commodity price support-allotment programs.

Farm Income

Net farm income or profit in Table 1 is gross farm receipts less expense. other than for land and for operator and family labor and managements

With allotments set at 100 percent of the 1963 level, average net income ranges from \$5,669 per farm with the cotton priced at \$17.60 to \$8,859 per farm with cotton priced at \$30.80. And with a given cotton price, net farm income decreases with lower cotton allotments. Thus, cotton prices and allotments have major impacts on net farm income.

Optimal Cotton Allotment-Price Combination

A national cotton allotment-price combination that maximizes net farm income to operator labor and management for the area under consideration was computed. It is not expected that such a combination would maximize returns for each and every soil situation and/or assumed representative farm situation within Southwest Oklahoma, or in the rest of the nation—to which the support prices and allotments would also apply. The formulation avoids the macro-micro inconsistency by assuming that all regions would receive adjustments from the 1963 level of support prices and allotments similar to adjustments received in Southwestern Oklahoma.

The aggregate net income function for Southwest Oklahoma was estimated by least squares regression from the aggregate net income data of Table 1:

$$\begin{aligned} Y &= 10{,}287.286 - 189.1818X_1 - 430.31957X_2 + 9.43723X_2{}^2 \\ &\quad + 10.34763X_1X_2 R^2 = .997 \end{aligned}$$

Where

Y = area aggregate returns to operator labor and management (\$1,000)
X_1 = allotment level as percent of 1963 base
X_2 = cotton price in dollars per hundredweight

Coefficients on X_1 and X_1X_2 were significant at the 99 percent level.

The government outlay equation based on domestic and foreign cotton demand, but adjusted to Southwest Oklahoma prices and share of national production, is:

$$G = -2991.5 + 11.09X_1 + 84.997X_2$$

Where G = level of government outlay (million dollars).

The equation shows the cotton price-allotment combinations that are available to cotton producers when the government spends G on a cotton program. The equation becomes the demand constraint in the following profit equation. Assuming, for illustrative purposes, that government outlay was \$553 million, the profit equation is:

$$\begin{aligned} \pi &= 10{,}287.286 - 189.1818X_1 - 430.31957X_2 + 9.43723X_2{}^2 + 10.34763X_1X_2 \\ &\quad + \lambda(553 + 2991.5 - 11.090002X_1 - 84.996622X_2) \end{aligned}$$

Where $\lambda \neq 0$ is an undetermined Lagrangian multiplier, π is profit (net farm income) and X_1, X_2 are as defined above.

The partial derivatives of π with respect to X_1 and X_2 are set equal to zero:

$$\frac{\alpha\pi}{\alpha X_1} = -189.1818 + 10.34763X_2 - 11.090002\lambda = 0$$

$$\frac{\alpha\pi}{\alpha X_2} = -430.31957 + 18.87446X_2 + 10.34763X_1 - 84.996622\lambda = 0$$

$$\frac{\alpha\pi}{\alpha\lambda} = 3544.5 - 11.090002X_1 - 84.996622X_2 = 0$$

Solving the above equations $\alpha\pi/\alpha X_1$ and $\alpha\pi/\alpha X_2$ for X_2 in terms of X_1, the results are: $X_2 = .171226X_1 + 16.87204$.

Substituting this value of X_2 into the equation for $\alpha\pi/\alpha\lambda$, the numerical value of X_1 is 82.3. The numerical value of X_2 is 30.96. Thus the profit maximizing combination of cotton price and allotment level for the Southwest area with a $553 million national government outlay is 82.3 percent of base allotment with a $30.96 per hundredweight cotton price.[2]

The results show that Oklahoma farmers who grow cotton receive a greater income with high national price supports and small national allotments than with low price supports and large allotments. Given a choice between small and large allotments that would apply proportionately to all cotton allotments in the nation, the cotton producer will receive a higher income with small allotments. This result depends on the elasticity of demand for U.S. cotton. The demand function used above is valid for approximately a five-year run. In a longer period, demand becomes more elastic as higher prices retard consumption through encouragement of synthetic substitutes and encouragement of foreign cotton production. In a period longer than five years, farm income might be greater with lower prices and larger allotments, given the government outlay for cotton programs.[3]

Value of Cotton Allotment

Data from the study were used to calculate the maximum average value of an acre of cotton allotment for various farm situations with allotments reduced 15 percent below the 1963 acreage. The 15 percent reduction in the clay soil farming situation at a cotton price of $26.40 per hundredweight necessitated a reduction in cotton of 17.86 acres. Returns to land, labor, and management were reduced by $183 in total, or an average of $10.25 per acre. The full value of this acre of allotment is the present value of its future income discounted to the present. Capitalizing the $10.25 net return per acre in perpetuity at 5 percent, the present capital value of an acre of allotment on clay soils was $205. This capitalized value was the maximum amount that the operator could afford to pay for an additional acre of allotment. Returns to operator labor and management would have to come out of the $10.25 annual amount. If he paid $205 to purchase an acre of cotton allotment, the operator would realize no return on the allotment to his labor and management.[4] Comparable average maximum values of cotton allotments for sandy, level loam large, level loam small, rolling loam large, and rolling loam small farms were $560, $159, $425, $238, and $325 per acre, respectively.

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[2] The national price is $35.18 but adjusted to Oklahoma is $30.96. The national allotment is equal to 82.3 percent of the 1963 allotment. Second order conditions for a maximum were met.

[3] The analysis was carried out under the assumption that a reduction in cotton allotment did not necessitate idling an equivalent number of cropland acres. Programming results indicated that forced idling had little effect on net returns when contrasted with a reduction in allotment without forced idling. The value of enterprises forced out by mandatory idling of land was low. Idled land was largely reseeded cropland and fallow land.

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[4] If operator labor valued at $3 per acre were subtracted from the annual value of allotments, the revised annual value of allotment would be $3 less per acre and the capitalized value $60 less per acre for each representative farm. A shorter planning horizon also would reduce the capitalized value.

Reference

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VIGNETTES: PRICE ANALYSIS AND MARKETING

CHAIRMAN: SHARON Q. HOOBLER, FEDERAL EXTENSION SERVICE

Effect of Merchandising Methods on Prices Paid at Cooperative Feeder Cattle Sales*

DAVID L. COLE

SPECIALIZED feeder cattle auction sales are held in all major beef production states. These sales have been developed primarily to market more effectively the feeder cattle produced by relatively small producers. Historically, the small feeder cattle producers have found themselves in a difficult market position because individually they lack sufficient volumes of uniform cattle to attract buyers to their farms. Their only market alternatives were local slaughter auctions or country buyers. As a result, small farm operators combined their cattle to obtain sufficient volumes to attract buyers. This was done under the assumption that cattle of varying grades, weights, and breeds were differentiated products in the minds of the buyers when available in sufficient quantities.

The purpose of this study was to analyze empirical data to identify and, when possible, to quantify the effect that specific economic factors have on the performance of feeder cattle auction sales. It has previously been shown that larger lot sizes and uniform cattle by grades, sex, and breed were significant factors in feeder cattle buyer decisions [1, p. 98]. It was also reported that the size of sale lot was important to the buyers of feeder cattle. It should therefore be recognized that, with variability in the feeder cattle that can be offered for sale, the quality of the lot is a major element in the buyer's decision to purchase feeder cattle and the price he is willing to pay. Hence, it is essential that producers and marketing agencies recognize the importance of this variability and understand how they can merchandise feeder cattle to sell to their advantage.

Methodology

The data used in this presentation were obtained from eight graded cooperative beef feeder cattle sales in 1966 and seven in 1967, conducted by the Michigan Cooperative Feeder Cattle Sales Association. Most of

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this information was obtained from the standard sales program available at the special auction sales.

The statistical method used to determine the influence of the independent variables on the price paid for feeder cattle was multiple regression and correlation analysis. Detailed market summary tables were used to aid in interpreting and generalizing results obtained. The market analyses were presented in an aggregative manner. However, individual market analyses also were made. Results of individual market analyses are studied in conjunction with the characteristics of each market's facilities and clientele before making recommendations. Two models were used to test the influence of factors on the prices paid for feeder cattle [2].

Model 1 was:

$P_{ijkl} = a + b_1G_i + b_2W_j + b_3L_l + b_4S_k + e_{ijkl}$ where
P_{ijkl} = average price paid per pound at the feeder cattle sales.
G_i = grade of the animal, $i = 1$ through 6, as shown in Table 1.
W_j = weight class, $j = 1 \ldots 13$, as shown in Table 1.
L_l = size of sale lot as a continuous variable.
S_k = sex of calf, $k = 1, 2$ for steer and heifer respectively.

Model 2 was like Model 1, except weight was treated as a continuous variable and lot size was divided into subclasses, as shown in Table 1. The variables considered were the variables found to be statistically significant by Cole in the Wisconsin Study [1, p. 98].

Results

Analysis by grade

In both models, grade was included as a dummy variable with the choice grade used as base. The U.S. Department of Agriculture official grade classifications were used, and grading was done by the Michigan Department of Agriculture. In some cases borderline cattle were combined into one lot, resulting in grade classifications of Choice to Prime and Good to Choice.

Regression analysis indicated that there were significant differences between the prices paid for Choice cattle and most other grades. In all cases differences were shown, but the differences were not significant for the Choice to Prime grade classifications in the 1966 sales and for the Good to Choice grade classifications in the 1967 sales (Table 1). The models indicated that for each full grade increase from Good to Choice and Choice to Prime, there was a general increase of $1.50 per hundredweight (Table 1). Cattle grading standard sold on the average for $6.77 less than Choice grade cattle.

Table 1. Regression coefficients and coefficient of correlation for all cattle sold through the Michigan Cooperative Feeder Cattle Sales during 1966 and 1967.

Independent variable[a]	Model 1		Model 2	
	1966	1967	1966	1967
	dollars			
Grade:				
Prime	1.50*	1.48*	1.42*	1.54*
Choice-Prime	0.41	1.10*	0.46	1.10*
Choice	—	—	—	—
Good-Choice	−1.21*	− .11	−1.32*	− .61
Good	−1.57*	−1.83*	−1.51*	−1.84*
Standard	−6.93*	−6.67*	−6.84*	−6.62*
Weight (pounds):				
a_2			−1.74*	−1.50*
0–249	3.46*	3.17*		
250–299	3.47*	2.67*		
300–349	2.69*	1.97*		
350–399	1.86*	1.33*		
400–449	0.83*	0.57*		
450–499	—	—		
500–549	−1.36*	−1.24*		
550–599	−1.89*	−2.31*		
600–649	−3.28*	−2.87*		
650–699	−3.61*	−3.44*		
700–749	−4.78*	−4.26*		
750–799	−4.66*	−4.37*		
800 and over	−4.46*	−4.81*		
Lot Size:				
a_3	0.03*	0.03*		
1– 5			− .79*	− .70*
6–15			0.00	− .34
16–25			—	—
26–35			0.26	0.43
36–45			− .20	0.76
46–55			1.29*	0.39
56–65			2.00**	2.77**
66–75				0.04
Sex:				
Steers	—	—	—	—
Heifers	−4.40*	−4.26*	−4.40*	−4.28*
Standard error of estimate	0.02	0.02	0.02	0.02
Multiple R^2	0.80	0.69	0.80	0.69
Number of observations (lots)	782	855	782	855

* Significant at .01 significance level.

** Significant at .05 significance level.

[a] Standard error of the regression coefficient between 0.19 and 0.99 for the estimate discrete values, weight, grade, and lot size.

Analysis by size of sale lot

Lot size was analyzed both as a continuous variable in Model 1 and as in discrete subclasses in Model 2. Lot size as a continuous variable showed that the number of cattle in the lot is a factor having significance for the buyer. Results were significant at .01 significance level and indicated that, as lot size was increased by one head in the range of 1–75 head, the price paid for each animal in that lot increased by $0.03 per hundredweight in 1966 and 1967 sales.

In Model 2, lot size was studied as a discrete variable, with size breakdown ranging from as few as 1–5 head per sale lot to as many as 66–75 head per sale lot. The deleted classification, or base to which the prices received for other classes were compared, was 16 to 25 head per sale lot.

Cattle selling in the 1–5 head lot classification received on the average $0.75 per hundredweight less than those in the 16–25 head lot size sale group. No additional significant differences from the base group were found between classifications until the lot size reached 46–55 head grouping in 1966 and the 56–65 head grouping for both 1966 and 1967. There were no lots larger than 65 head in the 1966 sales data nor any lots larger than 66–75 sales grouping in 1967.

Analysis by weight

Weight was studied as continuous and with discrete subclasses, as shown in Table 1. It was shown to be a significant factor when included in Model 2 as a continuous variable. As the average weight of a lot increased or decreased by 100 pounds in the range of 250 to 800 pounds, price was changed in inverse fashion on the average of $1.50 to $1.74 per hundredweight.

Analysis by sex

Sex (steer or heifer) was included in the analysis as a discrete variable. Heifers received significantly lower prices per hundredweight than steers in both the 1966 and 1967 sales. The $4.40 and $4.28 reductions in heifer prices per hundredweight as compared with steer prices primarily reflect the market for the fed cattle product.

Summary

A study of the factors affecting prices paid for feeder cattle at Michigan Cooperative Feeder Cattle Sales during 1966 and 1967 was conducted. Regression analysis with price the dependent variable indicated there were significant differences between the prices paid for Choice grade cattle and most other grades. Each full grade change from Good to Choice and from Choice to Prime showed a general increase of $1.50 per hun-

dredweight. Standard grading cattle were on the average discounted $6.77 per hundredweight less than Choice grading cattle.

The number of cattle on the sale lot were shown to be a significant factor affecting the price paid by buyers at the Michigan Cooperative Feeder Cattle Sales. Lot size viewed as a continuous variable indicated that the sale lot size was increased by one head in the range of 1–65 head, but on the average the price paid for the lot increased by $0.03 and $0.034 per hundredweight for each animal in the lot in 1966 and 1967, respectively.

When lot size was viewed with subclasses, it was found that, except for cattle in the 1–5 classification, no significant value differences were found between lot classifications and the base grouping until the number of head sold reached 46–55 head, as indicated by the 1966 data, and 56–65 head, as indicated by both the 1966 and 1967 data. Cattle sold in lots of 56–65 head received $2.00 and $2.77 per hundredweight (significant at the point at the .05 level) more than did those cattle sold in lots of 16–25 head for 1966 and 1967, respectively.

As the average weight of a lot decreased or increased by 100 pounds in the range of 250 to 800 pounds, price was changed in an inverse fashion on the average of $1.50 to $1.74 per hundredweight. When weight was divided into 50-pound classifications, it was shown that weight was a critical factor in the buying decision.

Steer calves received on the average $4.40 and $4.28 per hundredweight more than heifers in 1966 and 1967 respectively. This difference can be largely attributed to the market for the fed cattle product.

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Allocation of Florida Orange Production Among Alternative Product Forms and Market Sectors*

DAVID E. WEISENBORN

The Problem

AN important decision made each year by the firms comprising the Florida orange industry involves the allocation of a given supply among alternative product forms and marketing sectors. One criterion for this allocation is maximization of net revenue, which requires a knowledge of the relevant demand and cost relationships existing for the various product forms in the various marketing sectors. This paper reports the results of estimates of marginal revenues and marginal costs and their use in an allocation scheme that would maximize net revenue to the Florida orange industry.

The allocation process involves both the alternative forms of the final product (fresh oranges, frozen concentrated orange juice, chilled orange juice, and canned single strength orange juice), and the three alternative market sectors (foodstore, institutional, and export). There are several other product uses of Florida oranges, but the four product forms noted account for approximately 90 percent of the utilization of an annual crop.

While the methodological framework for solving optimal allocation problems for agricultural industries has been available for several years [2], there has been no previous attempt to apply the available methodology to an allocation of a given supply of Florida oranges over both alternative product forms and marketing sectors. The problem was previously defined to maximize total returns among various products in the foodstore sector by Minden [1].

The Data

With four product forms marketed through three market sectors, an attempt was made to estimate twelve different demand equations [3]. The data were obtained from numerous primary and secondary sources, and each of the equations was estimated at f.o.b. processor level using a single equation least squares linear regression model. Of the original twelve equations for which estimates were attempted, four were unacceptable.

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The remaining eight functions, however, represented the major products in each marketing sector and accounted for approximately 80 percent of utilization of an annual crop (Table 1).

Constant marginal cost functions were developed for each of the four product forms noted above [3]. Since the allocation problem was limited to the f.o.b. processor level, the cost estimation work relates basically to the fresh fruit packing and/or processing activities.

Table 1. Actual net revenue for the average season using actual quantities sold in each product-market category and maximum net revenue for the average season with a total quantity constraint of 73.22 million boxes, f.o.b. processor level.[a]

Product and market sector[b]	Actual		Maximum	
	Quantity	Net revenue	Quantity	Net revenue[c]
	million boxes	million dollars	million boxes	million dollars
FCOJ —F	38.49	14.47	27.76	24.32
COJ —F	6.47	31.08	4.88	14.49
CSSOJ—F	4.07	− 9.08	9.82	3.89
FFO —F	8.89	−17.74	20.12	11.38
FCOJ —I	4.68	1.16	5.55	− 2.98
COJ —I	6.87	12.99	0.69	0.44
FCOJ —E	2.50	1.81	4.14	− 1.80
CSSOJ—E	1.23	−18.62	0.26	−22.26
Total	73.20	16.07	73.22	27.48

[a] The quantity means are based on data from October, 1961, to October, 1967, for the foodstore and export product forms and December, 1963, to December, 1966, for institutional product forms.

[b] FCOJ is frozen concentrated orange juice, COJ is chilled orange juice, CSSOJ is canned single strength orange juice, FFO is fresh Florida oranges; F is foodstore, I is institutional, and E is export market sector.

[c] Negative net revenues arise in the optimum allocation when marginal net revenues are equated before fixed costs are covered.

The Model

Optimum allocation of a given season's production to various product categories and/or market sectors is based upon the theory of price discrimination. The problem was to determine the maximum net revenue for the Florida orange industry by equating the marginal revenue and marginal cost functions for the entire industry. The marginal revenue equations were derived from the demand equations for each product-market, while the constant marginal cost functions were developed from linear total cost functions. The constant marginal costs were deducted from the estimated marginal revenue functions to yield marginal net revenue functions. Maximum net revenue was then derived by an allocation that equated the marginal net revenue functions among product forms and markets.

Quadratic programming and the calculus with LaGrangean multipliers were two alternative methods considered for solving the revenue maximization problem. The calculus method was chosen because of its relative simplicity and programming ease.

The Results

The allocative procedure was carried out by solving the system of net marginal revenue functions for the quantity values. If the allocation is performed with no quantity constraint, the net marginal revenue functions are equated at zero. If total quantity is fixed, the net marginal revenue functions are still equated, but not necessarily at zero.

Actual quantities sold in each product-market were calculated for the average period used in the demand analysis. The actual net revenue figures were also calculated for each product-market at the f.o.b. processor level (Table 1). For the eight product-markets in the average season, the net revenue was estimated to be a positive 16.1 million dollars for 73.2 million boxes of oranges.

When the total quantity of oranges to be allocated was constrained to the average season quantity of 73.2 million boxes, maximum net industry revenue is approximately $27.5 million at the f.o.b. processor level (Table 1). This represented an increase of $11.4 million over the actual net revenue obtained from a comparable set of product-markets and total supply. A supply of 73.2 million boxes for the eight selected product-markets represents an overall Florida supply of 91.5 million boxes.

With supply unconstrained, net f.o.b. processor revenue was maximized at 111.4 million boxes for the eight product-markets or a total supply of about 139 million boxes. More importantly, the net revenue for the unconstrained solution was $85.4 million or $69.3 million above the actual net revenue for an average season. This allocation provided the largest overall net revenue among those attempted and resulted in sales of 24 million boxes of fresh oranges. This appeared unreasonable, given the competitive relationships existing between Florida, California, and Arizona for fresh oranges.

A subsequent unconstrained allocation excluded fresh oranges, which were arbitrarily set at 15 million boxes (Table 2). Net industry revenue was then $77.9 million and the optimum supply was reduced to 102.3 million boxes, as opposed to 111 million boxes when supply was unconstrained. A supply of 102.3 million boxes is equivalent to an overall industry supply of 128 million boxes.

Table 2. Maximum net revenue with unconstrained processed product markets and an upper constraint of 15 million boxes of oranges in the fresh foodstore sector

Product and market sector[a]	Quantity	Net revenue	Product and market sector	Quantity	Net revenue[c]
	million boxes	million dollars		million boxes	million dollars
FCOJ —F	34.17	32.48	FCOS —I	8.14	– 3.77
COJ —F	9.79	37.54	COS —I	11.86	17.74
CSSOJ—F	15.20	7.84	FCOS —E	5.95	– 2.14
FFO —F[b]	15.00	5.53	CSSOS—E	2.22	–17.33
			Total	102.33	77.89

[a] See footnote b, Table 1.
[b] Not included in the unconstrained allocation.
[c] See footnote c, Table 1.

Conclusions

The results of this study relate to the maximization of net industry revenue at the f.o.b. processor level. If, instead, the problem has been solved for maximization of net revenue at the grower level, the optimum industry supply would be somewhat less than the amount obtained for the f.o.b. processor level, since the price elasticities of demand are believed to be relatively more inelastic at the grower level.

The economics of price discrimination, as applied in this study, attempts to maximize the overall industry net revenue. In doing so, several product-markets suffer losses. If industry policy were formulated to require the maximization of net revenue, several product-markets would be expected to seek subsidies.

Finally, in the years that supply exceeds the estimated optimum, some form of abandonment or internal supply management would be necessary. Implementation of supply control programs normally requires state or federal legislation for enforcement.

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Criteria for Defining Federal Milk Order Market Areas

ROBERT E. JACOBSON

IN the regulation of fluid milk markets, definition of the market area in precise geographic terms is a critical issue because the designated market area is the basic means for identifying what milk is to be pooled and priced. The U.S. Department of Agriculture historically has emphasized two criteria in its decisions on boundaries of Federal order marketing areas. These criteria include (1) all of an area where the same milk dealers compete with each other for sales of milk, together with (2) the area where such milk must meet essentially the same sanitary inspection standards. An additional implicit consideration has been the tacit support or lack of specific opposition by the relevant producer interests, since it is the producer who finally votes in approval or rejection of the total order regulation.

In recent years, shortcomings of the specified criteria have become apparent due to the several technical and economic innovations in fluid milk marketing that have changed the structure of the industry from one of smaller individual markets to one of larger regional complexes. In spite of limitations of the market area criteria, the Federal order program has necessarily had to reflect the changes in the industry and extend market areas. As stated by the director of the Dairy Division, "With respect to larger geographic milk markets, the continuing expansion of Federal orders into previously unregulated areas and the merger of formerly separate orders testifies that the orders have been adapting to the fact that markets for fluid milk are rapidly becoming regional rather than local in scope" [1, p. 111].

Since present criteria for defining marketing areas are considered to be limited for optimal market delineation, a review of present criteria and identification of additional criteria should be helpful to the public decision process.

Both legal and economic considerations are relevant dimensions of the market area question. In a legal sense, the Agricultural Marketing Agreement Act of 1937 implied substantial flexibility to Federal milk order market areas by offering no direct limitations to market area size. In reviewing this factor, the Nourse Committee stated that " . . the Act is interpreted by the Department to require that milk marketing orders be issued for marketing areas in which the conditions of demand and supply are reasonably homogeneous" [4, p. 11].

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In an economic sense, usual definitions referring to a market as a closely interrelated group of buyers and sellers offer a general framework for evaluating market area. The essential question then concerns what criteria best describe the interrelatedness of buyers and sellers in fluid milk marketing.

Criteria for Market Area Definition

In addition to the criteria of competing dealers, uniform sanitary standards, and producer support, which have been utilized in market area decisions, measures of procurement area, general market organization, and Class II processing-distribution are advanced in this paper as relevant criteria.

Continued use of the area where the same milk dealers compete for sales is not arguable as one fundamental measure of what the regulated area should reflect. Probably no better means of achieving the orderly marketing objectives of the regulatory program exists than the systematic use of this measure. Sales area evidence is essentially a direct observation of the inter-relationship of buyers and sellers. However, this criterion does not answer the question regarding how extensive relationships must be to be viewed as the same market. Also, primary emphasis on competing handlers' sales territories for defining marketing areas is apt to make the regulatory program overly responsive to the distribution decisions and adjustments being made by milk dealers.

Uniform sanitary standards must continue as a factor in market area determination, but this factor is one of less importance than formerly. Extensive uniformity in sanitary standards has been accepted, and most markets are, therefore, not limited in a practical way by varying Grade A requirements. Widespread adoption of the U.S Public Health Service recommendations by state and local health departments, implementation of the Interstate Milk Shippers Program, and general employment of reciprocity arrangements among markets have all served to erode sanitary standards as a significant criterion for market area definition.

Acceptance and support of the market area proposal by producers (cooperatives) is a pragmatic consideration which cannot be avoided in the regulatory procedures. While such acceptance is essentially remote as an indicator of buyer-seller relationships, required producer support in referenda diminish the possibilities of rejecting this factor, at least in the short run.

The procurement area is becoming an increasingly important criterion in defining marketing areas. This is due in part to the greater mobility of milk in procurement through bulk assembly. The procurement criterion becomes of particular importance when there is substantial milkshed overlap with potentially unstabilizing differences in producer pay prices.

In some market area decisions, the procurement area aspect has already been articulated as a rationale for defining the market area. For example, in connection with the merger of the Muskegon and Southern Michigan Federal orders, the decision stated: "The overlap of distribution and supply routes has progressed to the point that a separate Muskegon market for producers can no longer be distinguished . . . By providing proportionate sharing among all producers of total Class I sales in the market, the merger will stabilize prices and eliminate much of the present price uncertainty . . ." [3, p. 7904].

It seems logical to recognize directly the procurement area as a market area criterion (1) if it is already on occasion being considered on that basis, and (2) if it adds substantively to the description of buyer-seller relationships. Since matters of price instability and equity are recognized concerns of the Federal order program, and since procurement area relationships have a major effect on these matters, procurement area evidence should be used as a basic measure for market area definition.

General market organization as a marketing area measure implies a simultaneous look at some of the elements of both procurement and distribution. The problem of using this criterion is that it eludes the precise definition required for introducing and analyzing relevant evidence in the public decision process. However, the value of general market organization is that it can add essential elements to the description of buyer-seller relationships. Dimensions of general market organization that can be more precisely evaluated include (1) working relationships among cooperatives, (2) compatibility of Federal order provisions, and (3) market structure and organization (milk dealers) [2, p. 23].

Working relationships among cooperatives are particularly important because moves to larger or consolidated marketing areas usually mean that several cooperatives will be affected and will be operating within the same regional market order. The extent of working relationships among cooperatives can be observed in terms of (1) federations for bargaining purposes among the subject cooperatives, and (2) cooperation in meeting full supply requirements and disposition of surplus milk.

Increased uniformity and integration of provisions among Federal order markets de-emphasizes compatibility of order provisions as a factor in defining market areas. However, variations in seasonal price plans and Class I pricing procedures (particularly supply-demand adjustors) continue to indicate that such variations must be recognized as the market area definition is reviewed.

Evidence on market structure and organization offers a direct observation of interrelationships among buyers and sellers. Priority information in this area includes operations of national and regional dairy firms, national and regional food store chains, vertically integrated fluid milk operations, arrangements between handlers for reciprocal processing, and highway transportation in the proposed area.

Class II processing-distribution as a factor in market area determination has become significant in recent years due to (1) increased concentration of Class II product processing in a small number of large plants, and (2) wider application of the Grade A requirement on Class II products, particularly intermediate products such as ice cream and cottage cheese. As a result, some Federal order markets are necessarily pooling surplus milk to be used in intermediate products and destined for other markets, while such other markets are maintaining high utilizations and are depending on the outside sources for these products. This type of situation raises a basic question of equity and sharing of surplus among markets since it leads to wide variations in utilization among markets. Therefore, inclusion of evidence on Class II processing-distribution in defining market areas would provide further information on buyer-seller relationships and would help resolve one unstabilizing aspect of market area delineation.

Evaluating Criteria for the Public Decision

It is postulated that consideration of the several criteria offers a stronger and more balanced base for identifying the optimal market area than does the more limited emphasis on sales and sanitary standards. Furthermore, consideration of the six factors divorces the regulatory program from some of the uncertainty associated with dynamic adjustments taking place in distribution patterns. The question remains, however, as to how evidence on the several criteria can be integrated to provide a best decision on boundaries of the market area.

It is recognized that each measure may suggest something different with respect to size of maketing area. Also, any single measure taken by itself could have implications finally suggesting, for example, a national marketing area. To keep this type of total area decision in perspective, it is emphasized that by using the six criteria concurrently, with no preference given to any of them, and letting the evidence on each criterion determine its relative merit, a balanced type of judgment should be realized that will provide the most effective type of marketing area.

As a final note, an additional option should be utilized by the U.S. Department of Agriculture and recognized directly in market area decisions. Historically, market area expansions have been made by (1) adding unregulated adjacent areas to the marketing area, and/or (2) consolidating marketing areas. A third option, that of transferring a portion of one market area to another Federal order is becoming more relevant and should be part of market area policy. The rationale for needing this option is that, in given situations, milk market relationships have changed so much that earlier marketing area formulations do not reflect the state of current marketing relationships. A portion of one market may now be more closely associated with an entirely different market. The regulatory program should have the flexibility of recognizing such changes as market area decisions are made.

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Price Discrimination in the Food Industry: A Competitive Stimulant or Tranquilizer?

R. E. SCHNEIDAU AND RONALD D. KNUTSON

THE food industry has played a central role in the establishment, evolution, and interpretation of the Robinson-Patman Act. In 1934 the Federal Trade Commission (FTC) chain store investigation found that discriminatory price concessions given chains by food processors were in part responsible for the chains' competitive advantage [2, p. 155]. This landmark investigation of the food industry contributed materially to the ultimate passage of the Robinson-Patman Act in 1936 [14, p. 171].

Through time, discriminatory practices of food processors and the exacting power position of chains have continued to play a central role in the interpretation and enforcement of the Robinson-Patman Act.[1] The National Commission on Food Marketing found that from 1951 to 1964 the FTC had made 1,792 formal investigations of discriminatory preferences affecting retail food distribution [14, p. 172]. Between June 1950 and June 1964, the FTC filed 53 complaints against food marketing concerns charging illegal discrimination [14, p. 176].[2]

The purpose of this paper is to provide insight into the interpretation of what constitutes discriminatory pricing practices and to examine the motives for discriminatory behavior in the food industry. It is hoped that the article will provide a basis for placing the concept of price discrimination in a broader context than is traditional in economic theory.

Problem

Although economists go to considerable lengths to theoretically distinguish among the various degrees of price discrimination [15, p. 279; 16, p. 179], there has been little analysis of the role price discrimination plays

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[1] Landmark Supreme Court decisions include rulings against major pie baking companies for giving discriminatory allowances to purchasers of pies [19], geographic discriminatory allowances by brewers [7], discriminatory allowances by sellers of salt to grocery retailers [10], private label discriminatory allowances in evaporated milk [8], and unjustifiable quantity discount differentials in fluid milk distribution [18].

[2] Nine of these complaints were issued against dairy processors, six against processors of fruits and vegetables, seven against bakery companies; ten were other food industry complaints. In addition, 155 complaints against food concerns were based on sham brokerage payments [14, pp. 176–177].

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in the competitive process. To many people, the charging of discriminatory prices is an undesirable practice because it is associated with monopoly power, market exploitation, and income redistribution [6]. Others have found that the evolution of discriminatory pricing practices is an integral part of our competitive system and, as such, discriminatory prices are not undesirable unless they are stable or permanent in nature [1]. The latter view recognizes that the essence of competition is a search by business managers for the most profitable sales opportunities.

It is the exploratory hypothesis of this article that this conflict with respect to the probable effect of discriminatory pricing is related: (1) to the difference between lawyers and economists as to what constitutes discriminatory pricing, and (2) to a lack of recognition of the motives for discriminatory pricing.

Price Discrimination Defined

There is a distinct difference as to what constitutes price discrimination in the legal sense and in the economic sense. Economists consider price discrimination to exist when price differentials cannot be justified by cost differentials, or when prices are the same but costs are different. It follows that price discrimination ". . . is rigorously defined as a difference in profit earned by one customer as against another" [1, p. 223].

The Robinson-Patman Act is concerned only with price differentials not based on costs. Whereas economic price discrimination knows no geographic bounds, price discrimination to the legal profession applies only to sellers who are in competition with each other. The law views price discrimination as being an unfair trade practice, designed to reduce competition. The law does, however, have three major exceptions: (1) the product must be of like grade and quality; (2) it must be determined that the discrimination may injure competition or tend to create a monopoly, or injure, destroy, or prevent competition with any person who grants or knowingly receives the benefits of the discrimination, or with customers of either of them; (3) discrimination may be practiced when it is done to meet competition [17].

It follows that the legal definition is considerably narrower than the economic definition. Furthermore, the normative implications of the competitive behavior of firms in a market are considerably different. Thus, the economist's judgment of whether competition has been impaired by discriminatory practices will likely be at odds with that of the lawyer. For example, while the Robinson-Patman lawyer may consider a pricing system under which prices are stable and price differentials among buyers do not exist to be functioning well, an economist would consider such a situation indicative of monopoly practices. Indeed, the existence of discrimination may imply that the competitive process is functioning, while under the

Robinson-Patman definition discrimination may be interpreted as detrimental to competition. In a recent Supreme Court decision, three national pie bakers were convicted of illegal discrimination when they attempted to enter, by discriminatory pricing, a relatively isolated independent pie baker's market. Prior to the discrimination, the independent enjoyed a near monopoly position in the market [19].

The conflict becomes even more apparent when it is realized that under concentrated oligopoly a price adjustment in response to a cost decrease may not occur without a discriminatory price concession [11, p. 160]. Furthermore, the argument can be made that production of given products might not occur if price discrimination could not take place [15, p. 203].

Though economic theory is adequate to explain the role and implications of price discrimination, its application is frequently restricted to a single product, multiple market case [6, p. 179]. The classical example is a situation under which demand elasticities are different in two markets. The firm attempts to maximize profits by limiting output in the more inelastic market and casting the surplus off into the more elastic market. A variation of this theme exists when profits are maximized by segmenting the demand in a given market by the use to which a given product may be put. Of course, a market may be segmented simply because different customers are able and willing to pay different prices.

This view of price discrimination has caused economists to concentrate on the static optimum prices and quantities resulting from a given market situation. They thereby avoid recognition of the role of price discrimination in disequilibrium.

Motives for Price Discrimination

While some economists have studied methods of price discrimination [12], little attention has been given to short-run dynamic motives underlying the use of these methods. These motives are central to the ultimate effects of price discrimination. It is, of course, recognized that the long-run motive for price discrimination is profit maximization or growth. The effects of the short-run motive may be quite independent of the long-run profit maximum.

Market entry

Price discrimination is one of the primary means of obtaining market entrance. A food processor may give a retailer a special discriminatory price concession in order to penetrate a new market. It can be assumed that the new market will, over time, yield the processor a net profit. In the short run, however, there may be no attempt to maximize profits, no attempt to segment the market, and no attempt to gain advantage through differences in demand elasticities. Several techniques may be used to accomplish the entry motive, depending upon the economic organization of the market and the anticipated response of rivals. Whatever the technique used—price cutting, rebates, etc.—certainly, price discrimination in a legal and economic sense has taken place. After entry has been accomplished, it can hardly be inferred either from a short- or long-run competitive standpoint, that market entry discrimination is undesirable, unless accompanied by an intent to monopolize.

Improving market position

Discrimination is frequently used to expand sales within a market after market entry has been accomplished. Such discrimination may be motivated by a desire to increase sales, and thereby utilize unused plant capacity, or by a desire to gain market power. If motivated only by the desire to utilize unused capacity, the economic effect is not necessarily undesirable. Here again, in the short run, little use may be made of classical considerations motivating price discrimination.

Maintaining market position

In a dynamic economy, we are ever witnessing changing competitive structures and conditions within markets which dictate price changes. A study of pricing in oligopolistically structured fluid milk markets revealed that, through time, special discriminatory concessions were given to large volume preferred customers. These concessions eventually spread across the market, resulting in an overt price change. Distributors stated that discrimination was an essential competitive tool in their markets for accomplishing price change and maintaining sales [11, p. 160].

Firms may also discriminate in price to maintain product line sales. Price discrimination may occur when attempts are made to maximize profits for the blend of products sold. For any individual product, price differentials not based on cost exist for different purchasers. For example, consider a meat packer producing 20 major closely related meat products. The packer gives retailer X a discriminatory allowance for a product such as ham—a good grocery special. At the same time the packer gives a discriminatory allowance on bacon to retailer Y—a competitor of X. For both X and Y the packer attempts to make up for the discriminatory allowance on the other 19 meat products, so that the blend price and ultimate profit are equal for both retailers. Such a sales strategy complements the retailer's pricing strategy and therefore helps the packer to maintain sales on his total product line.

Price discrimination in the sense of maintaining market position may also be used to discourage market entry. A firm may maintain lower prices in one market than in another to discourage competitors from attempting market entrance. Although such discrimination may constitute a barrier to entry, one cannot a priori say that the market results would be more or less desirable than without discrimination.

Price discrimination to discourage entry is, of course, closely related to discrimination motivated by the need to meet competition. This exception, as indicated previously, is included in the Robinson-Patman Act.

Conclusions

It is apparent that price discrimination is an important short-run competitive tool in the food industry. Whether price discrimination has a competition enhancing or suppressing effect is largely a function of the motives for the discrimination and the length of time the discrimination exists in the market. Since the same method or technique of discrimination may be utilized for entirely different motives, it is the motive that is important in determining the effect of discrimination, *not* the technique. While economists have largely neglected the short-run role of price discrimination, the law appears to incorrectly assume that a primary motive for price discrimination is monopoly and, thus, that price discrimination has little place in the competitive market. One can, however, argue that the distinction made here is moot, since the standard of legality under the Robinson-Patman Act is a lessening of competition. Yet cases in the food industry, such as *Utah Pie,* indicated that the court tends to confuse injury or lessening of competition with injury to competitors, whereas injury to competitors is a normal and expected part of our competitive system. Our price discrimination legislation, in certain cases, appears to be stifling rather than stimulating competition in the food industries.

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Consumer Attitudes Toward Milk Substitutes

ROBERT C. ANGUS AND J. WARREN STULL

THE dairy industry is confronted with the encroachment of substitute milks into the fluid market. These products are new in terms of market availability, even though the technical development took place in the fifties. Marketing substitute milks introduces the butter-margarine controversy in a new form. Substitute milks have been sold at lower prices than regular milk because butterfat has been replaced by relatively low cost vegetable oils. The product is available in approximately 20 states and sales are expanding. The rapid growth in the relative market share of filled milk in Arizona, to 10 percent of Class I producer milk since its introduction in October 1966, has drawn the attention of those people particularly concerned with evaluating the competitive potential of fluid milk substitutes.

The purpose of this paper is to present the results of a study of factors that may explain the acceptance of filled milk in terms of consumer attitudes and, alternatively, in terms of the different characteristics of consumers and nonconsumers of filled milk. The results of our study are compared with a study made by the Milk Industry Foundation [1]. These two studies were completely independent; the investigators had no knowledge of the other until the field work was finished.

Information was obtained on consumption, price, and place of purchase for 56 food products. Respondent households were selected at random from the Phoenix area during June 1968. Attitudes toward milk products were investigated by using 30 polar statements with a seven-unit intensity scale. To facilitate discussion, these results have been divided into three categories: (1) product use, (2) consumer characterics, and (3) nutritive characteristics.

Product Use

Respondents were less familiar with imitation milk than with whole milk. Of those questioned, nearly half had never heard of imitation milk. Six times as many families used milk frequently as those who used imitation milk often. A ratio of 3:1 was found between those who never used imitation milk and families that never used regular milk.

Families that purchased substitutes the previous week consumed an average of 10.9 quarts of milk-type beverage per week, 4.9 quarts of regular milk, and 6.0 quarts of substitutes. Those families who did not purchase

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substitutes "last" week consumed a total of 10.1 quarts of milk per week.

The MIF study reported weekly household consumption of whole milk, other milk, and substitutes as 9.26 quarts. This figure includes .75 quarts of substitutes. Nonusers of substitutes consumed 8.96 quarts per week while substitute users had a milk-type beverage consumption of 13.98 quarts, composed of 4.5 quarts of whole milk, 1.83 quarts of other milk, and 7.65 quarts of substitutes.

Milk consumption figures from the two studies are in close agreement. The proportion of total milk beverage consumption accounted for by substitutes for regular users was 54.7 percent in the MIF study, 55.1 percent in the Arizona work. Less regular milk is consumed by families who purchase substitutes. The difference was statistically significant.

A key toward evaluating potential market acceptance of substitute products may be found in the volume sold in Arizona. At present, about 10 percent of the Class I producer milk is filled milk products. This proportion has been stable since July 1968.

Price comparisons for the Phoenix area found imitation milk selling for 39 to 43 cents per half gallon during June 1968. Regular milk was priced from 53 to 56 cents. The MIF study reports a seven- to nine-cent spread between these prices for July 1968.

Consumer Characteristics

Chi-square tests for independence of samples were used to examine the polar statements related to consumer characteristics.

The attitude proposition, "Not liked by children . . . Liked by children," resulted in a 7:1 ratio between imitation milk and regular milk on the "not liked" side. The ratio was 4:1 in favor of whole milk on the "liked" side.

Frequencies for the "Liked by adults . . . Not liked by adults" question pointed to a preference for regular whole milk. Imitation milk was liked by the entire family for only 14 percent of those interviewed.

Two questions dealt with sex differences via the "Women's drink . . . Men's drink," "Boy's drink . . . Girl's drink" scales. Imitation milk is considered by many to be more a woman's beverage. However, the "boy-girl" scale did not reveal significantly different frequencies. One explanation is that respondents thought imitation milk had fewer calories, was watery, and was for weight watchers. Thus, the imitation beverage may have more appeal for women than for girls who would have less serious calorie control problems.

The responses on "For company . . . Not for company" indicated regular milk was the drink to be served guests. One explanation is that imitation milk may be thought of as an inferior product. Regular milk was preferred for personal use.

The next step in the analysis consisted of an examination of the difference between families who purchased imitation milk last week and those who did not. This comparison includes the following factors: (1) education of homemaker; (2) disposable family income; (3) family expenditure for food eaten away from home; (4) size of household; (5) age of homemaker.

The average homemaker in families who purchased imitation milk had significantly more education than her counterpart. The difference was very small; imitation milk users completed one trimester while nonusers had four years of high school and no college.

The disposable family income for users and nonusers was not significantly different. The nonuser group averaged $7892 opposed to $7929 for users. Comparison of these income figures with those in the Milk Industry Foundation study is difficult because of the refusals and the wide income classifications in the MIF report. The MIF report concludes: "It is clear that substitutes are not being purchased primarily by the lower income groups." This conclusion is supported by the Arizona results.

No significant differences were found between the users and nonusers for family expenditures, for food eaten at home, or for expenditures for food eaten away from home.

The average size of household for purchasers of imitation milk was 4.6 persons versus 3.9 in the other group. This difference was not significant. The MIF study reported a higher proportion of larger families were regular users of milk substitutes than smaller families. The Arizona results agree, but again the difference was not significant at the five percent level.

No significant difference was found between the groups with respect to the age of the homemaker. Perhaps number of children under 16 years would have been a better variable.

Nutritive Characteristics

The ingredient characteristics of substitute milk beverages vary widely because standards of identity have not been adopted by most judicatory areas. The fat used in many products is based on hydrogenated vegetable oils. In some filled milks, isolated proteins are used in addition to unspecified amounts of nonfat milk. Likewise, there is variation in fortifying these beverages with minerals and vitamins [2].

Questions dealing with vitamins, calories, general nutritive value, protein, and calcium were included so that consumer knowledge could be compared with product characteristics. Responses relating to caloric content were particularly interesting. Seven times as many indicated imitation was low in calories as compared with regular milk. This opinion is not supported in fact. Filled milk has approximately the same fat and nonfat content. This result is supported by the MIF study where 63.9 percent of occasional users of milk substitutes believed these had fewer calories than regular milk. Regular milk was considered to be less watery or richer and more stylish. Families frequently pointed out a greater uniformity in the quality of regular milk. The response to "For weight watchers . . . For thin people" showed that the imitation product was thought of as a weight watchers beverage. Consumers identify the substitute with diet type or low fat beverages.

The protein question resulted in high ratings for regular fluid milk. Consumers are generally aware of the relatively high calcium content of whole milk. In reality, filled milks have the same protein and calcium content as whole milk, provided the nonfat solids proportion is equivalent.

The preceding analysis was based on the entire sample of users and nonusers of imitation milk. The breakdown of contingency tables has been extended to compare attitudes toward imitation milk by those who had purchased the product last week and those who had not. There were no significant differences between purchasers and nonpurchasers of imitation milk in their attitudes toward product content of vitamins, calories, protein, calcium, and general nutritional value. Nor were there any significant differences between imitation milk purchasers and nonpurchasers in their attitudes toward regular milk with respect to content of vitamins, calories, and protein. In summary, both groups were equally well informed and equally confused about regular and imitation products.

Conclusions

Attempts to explain why consumers ranked imitation milk and whole milk as they did verge on speculation. However, one must note the attitudes that do not conform to reality. The major one was the low evaluation for caloric content of imitation milk, which led to ranking it as a diet product . Second, regular whole milk has a "good" and "wholesome" image, a factor which may have led families to answer favorably for regular milk even though they had little or no knowledge on a specific question.

The University of Arizona research and MIF work agree closely. The real question deals with directions for additional investigation. Is our information base good enough to form market policy?

A naive multiple regression model was constructed with milk consumption as a dependent variable and a set of quantifiable demographic variables as independent variables. The coefficient of multiple determination (R^2) was .397. The significant variables were as follows: education of homemaker, a negative relationship expenditures for food eaten at home and away from home, a positive relation; and number of persons in the household, a positive relation. Disposable family income and the age of the homemaker were not significant. Additional independent variables can be added from the data. One example would be the number of family members under 16 years of age. Intercorrelations among independent variables are a serious problem in this type of analysis.

The point in discussing this regression analysis is that it highlights the problems for researchers. The real problem for researchers is identifying the relevant variables that are related to milk and substitute milk consumption.

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Hidden Consumer Motives in Supermarket Selection

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THE structure of the retail food industry has undergone significant changes since the Korean War period. At that time there were three major groups in the industry. Today there are only two significant groups, the corporate chains and the affiliated independents. The latter behave much as corporate chains in that the stores operate with common management or supervision. This fact alone accounts for much of the attention and concern of many in our economy about the competitive behavior of food distribution firms.

This changing structure has resulted in increased competition among supermarkets in non-price competitive tactics such as advertising, services, customer conveniences, etc. There is little evidence to support the theory that consumers actually demand or are influenced by many of the customer conveniences that retailers provide. The primary objective of the research reported here was to identify and define the basic consumer motives in selecting a supermarket. With this new insight, it will be possible for the retail food industry and the economist or marketing theorist to better assess the value or importance of the competitive tactics being used to attract consumers to a given supermarket.

Study Description

A sample of 300 consumers was randomly selected from the north-central part of Franklin County (Columbus), Ohio. This area was selected because of its diversity of income and education levels and fair representation of ethnic groups. This area is well represented by all the retail food firms that operate in the central Ohio market.

Annual incomes for the families of the sample ranged from less than $2,000 to over $15,000, with a median income of approximately $7,500. Educational level of the household head ranged from some grade school to completion of graduate work. The median education for the sample was slightly more than 12 years of schooling. Eighty percent of the respondents ranged from 25 to 54 years of age.

The questionnaire used in this study was in three parts: Part I, shopping habits of each respondent; Part II, a self-administered section in which the respondent rated 87 motivational statements related to supermarket shopping; and Part III, demographic data, such as income and ed-

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ucation of each respondent. The 87 motivational statements were the result of an analysis of previous studies and "brainstorming" with a group of food industry leaders. An effort was made to include all possible statements that might be part of the individual consumer decision-making process; these were reduced to 87 after pretesting in the Cincinnati market. Arranged in alphabetical order, the statements were rated separately by respondents on a scale from 1 to 7 (the higher the number, the greater the importance to the consumer in selecting a supermarket). A typical statement was worded: "Express checkout is available."

The Analysis

Through factor analysis, the 87 statements were reduced and simplified to eight basic motivational factors. Identification of each factor was based upon the factor loadings or correlations of each statement with the isolated factor. The square of the loadings is similar to r^2 in correlation analysis. Only loadings of .40 or above were included when identifying the factors in the study. Once the loadings or the individual statements were obtained for each factor, each was identified and named. The name given to the factor represents the statements with the significant loadings (.40 or above) on the factor. A summary of the eight factors with key identifying statements follows:

Factor A: *A Pleasant Shopping Experience* (14.3)

Clerks are friendly and helpful	.77	Clean shopping carts	.65
Shelves are well stocked	.75	Manager is friendly	.65
Store is clean and neat	.74	Plenty of parking space	.64
Floors are clean	.71	Easy access to/from parking lot	.63
Wide selection of foods	.69	Aisles are wide	.63
Fast checkout service	.68	Checkout girls are friendly	.60
Arrangement allows easy shopping	.67		

Factor B: *Prices* (6.0)

Low fresh meat prices	.75	Meat special regularly featured	.61
Low everyday prices on groceries	.74	Low sugar prices	.59
Low prices on canned goods	.73	Good weekly low price specials	.57
Fresh fruit and vegetable prices considered low	.64		

Factor C: *Social Influences* (5.8)

Store frequented by young housewives	.82	T.V. advertising conducted	.55
Store frequented by all age groups	.77	Friends and neighbors shop where I do	.47
Store is busy (many people shop there)	.70		

Factor D: *Near Other Services* (5.6)

Near group of stores	.81	Near drugstore	.69
Near ten cent store	.75	In a shopping center	.67
Near bank	.73	Near service station	.64

Factor E: *Meats* (5.5)

Tender meat is sold	.78	Wide selection of meat	.61
Fresh bright appearing meat	.77	Meat is free of excess fat	.55
High-quality meat	.72		

Factor F: *Advertising* (4.1)

Ads are easily read	.64	Advertised specials always available	.54
Ads have friendly tone	.64		

Factor G: *Convenience* (2.8)

Packaged meats offered	.67	Open weekday evenings	.40
Delicatessen foods are available	.50	Open Sundays	.40
Fruits and vegetables prepackaged	.47		

Factor H: *Location* (2.3)

Within one mile of your residence	.71	Within walking distance	.67

The percent of total variance among all statements that is explained by each factor is shown in parenthesis. While eight factors explain only 46.4 percent of the total variance, the more important factors that influence the consumer in selecting a supermarket have been identified.

The Results

The analysis clearly revealed some new dimensions to be considered regarding consumer motives in supermarket selection. Many of these factors have been hidden or beyond the conceptual view of the food industry and marketing people. The food industry has not been "tuned in" to the consumer. This was the finding when 186 members of the food industry at the Ohio Food Distribution Conference responded to Part II of the questionnaire. The conference participants were retailers, food manufacturer representatives, brokers, and food marketing educators. They were asked to rate the 87 statements as they thought the consumer would rate them. In summary, the identified factors for the food industry personnel are compared with the factors isolated by consumers in Table 1.

Implications

The factor *A Pleasant Shopping Experience* was not isolated as a motivational factor in supermarket selection by the food industry. The consumers view this factor as consisting of six variables: friendliness, selection, cleanliness, parking, fast checkout service, and ease of shopping. As a result of this finding, it is logical to conclude that, as the presence of these variables increase (in a positive way), the probability that the shopping trip will be pleasant increases. All are variables that can cause irritation to the consumer from the time she enters the parking lot until she leaves the checkout. These are variables that are largely a function of store management.

The factor *Friendliness and Perishables* was isolated by food industry

Table 1. Consumer motivational factors in supermarket selections

Factors	Contribution to total variance	
	Consumers	Food industry
	percent	
A pleasant shopping experience	14.3	x
Prices	6.0	6.1
Social influences	5.8	4.9
Near other services	5.6	5.3
Meats	5.5	x
Advertising	4.1	3.8
Conveniences	2.8	3.2
Location	2.3	x
Friendliness and perishables	x	9.4
Front-end	x	3.4
Modern appearances	x	3.3
Trading stamps	x	2.7

personnel. There are high loadings on this factor related to friendliness, meats, and produce. Recall that consumers considered friendliness as part of *A Pleasant Shopping Experience* and considered *Meats* as a separate motivational factor. The food industry also isolated two additional factors identified as *Front-End* and *Modern Appearance.* These are factors that food industry trade publications have given much attention to during recent years, which may explain why they were identified by the industry but not by consumers.

Observe that *Location* was not identified as a separate factor by food industry personnel; instead, they combined *Near Other Services* and *Location* as one motivational factor, while consumers separated these into two factors. Thus, consumers think of a store as being near their place of residence or near other stores. The recent trend of the food industry to establish neighborhood free standing stores suggests that they have become alert to this distinction.

It is significant that the food industry identified *Trading Stamps* as a motivational factor while consumers did not. The evidence suggests that trading stamps are not an important motivational factor to consumers in supermarket selection.

The eight factors identified by consumers provide the retail food industry with new understanding of the consumer and what influences her in her selection of a food store. These isolated factors may be categorized as internal and external factors, as follows:

Internal (within the store)

A Pleasant Shopping Experience
Meats
Prices
Conveniences

External (outside the store)
- Advertising
- Location
- Near Other Services
- Social Influences

Looking to the future, it may well be particularly meaningful to train store managers in terms of the four basic motivational factors classified as internal. The store manager who makes greater efforts to insure the consumer a pleasant shopping experience, better meats, lower prices, and improved conveniences will likely experience increased volume which, in turn, should result in greater profits.

VIGNETTES: PRODUCTION ECONOMICS AND FARM MANAGEMENT

Chairman: Raymond M. Leuthold, University of Illinois

A Decision Model for Continuous Sequence Production Processes of Variable Length: An Application to Hog Marketing*

JOHN E. IKERD AND ALVIN R. SCHUPP

PROFIT maximization over time is the goal of economic production regardless of whether the production process is of fixed or variable length. The classical criteria for profit maximization are consistent with maximization over time when the production process is of fixed length. Variable length production processes, as encountered in livestock feeding, require somewhat different criteria from those given by the classical theory of the firm. The length of a process can affect both production costs and revenues (e.g., length of feeding of livestock). When there is a time lag between the end of one variable length process and the beginning of another, profit maximization is achieved by extending the process so long as the extension results in additions to revenue greater than or equal to additions to cost.

When there is no time lag between the end of one variable length production process and the beginning of another (i.e., continuous sequence production), the problem is to maximize profits per unit of time rather than from any one production process [1, pp. 162–170]. Few marketing decision models have been developed for this type production. Faris [2] develops a set of criteria for the specific case of a continuous sequence of two production periods. This paper develops the criteria for the general case of a continuous sequence of *m* variable length periods and applies it to the hog producer.

The producer using this model compares the discounted expected value of marketing his hogs in the present time period with the discounted expected value of marketing one time period into the future. If a producer markets his hogs in the present time period, he has excluded some of the possibilities of future marketings, in terms of both prices and market weights, that would have been open to him had he chosen to sell in the fol-

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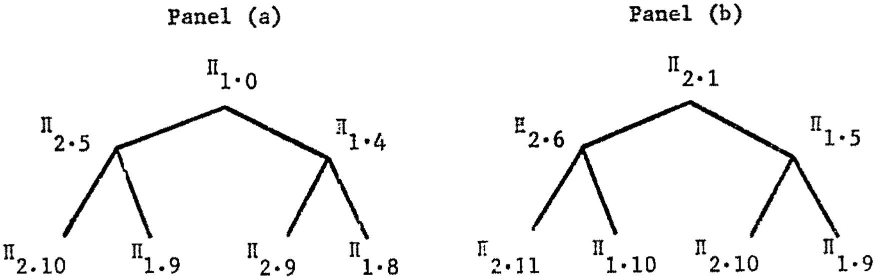
Figure 1. Marketing possibilities for a two-period planning horizon[a]



[a] Explanation of symbols:

$\Pi_{1\cdot t}$ = Possible profit (revenue minus costs) per day from hogs fed more than 4 but less than 5 months and marketed t months from the present.

$\Pi_{2\cdot t}$ = Possible profit (revenue minus costs) per day from hogs fed more than 5 but less than 6 months and marketed t months from the present.

lowing time period. But if he decides to hold his hogs one more period, he has excluded some possibilities that would have been open had he chosen to market in the present time period. Under conditions of uncertainty, the goal then is to make the decision in such a way as to leave open the most profitable set of possibilities considering both present and future marketings.

Assume that the possibilities open to the decision maker who has a lot of 4-month fed hogs are to sell now or to sell in the next month. Figure 1 shows the expected net returns possible (within a two period planning horizon) for each of the alternatives. Panel (a) shows the possibilities open to the producer if he chooses to market in the present month, and Panel (b) shows similar possibilities for marketing in the following month.

By appropriately weighting and discounting the expected profits from each set of possibilities, the alternative promising the largest expected returns can be determined. Downward trending prices would favor the decision to sell in the present time period resulting in lighter market weights. On the other hand, upward trending prices would favor the decision to hold the hogs longer resulting in heavier market weights.

The model assumes the following:

(1) The individual producer desires to maximize net expected profits from his planning horizon.
(2) The producer chooses initially to market in one month (4-month hogs; month 0) or the succeeding month (5-month hogs; month 1).
(3) Replacement feeder pigs are available when required to keep facilities efficiently utilized.
(4) Producers marginal cost curves rise with increasing weight.
(5) The production cycle encompasses a 4 or a 5 month period.
(6) Expected profits per day within a given month are relatively constant.

(7) Homogeneous initial weight for feeder pigs and uniform weight gain over the production period for all animals within the lot.

(8) Producer has access to reliable profit estimates for future marketings.

The relationship showing expected returns from the two sets of possibilities (shown on the diagram), appropriately weighted and discounted, can be expressed in two equations which define the general m period decision model:

$$E(V_0) = \sum_{p=0}^{m} \sum_{t=4^p}^{4p+p} \frac{1}{(m+1)2^p} \left[\left(\binom{p-1}{k} \left(\frac{\Pi_{1 \cdot t}}{(1+r+z)^t} \right) \right) + \left(\binom{p-1}{k-1} \left(\frac{\Pi_{2 \cdot t}}{(1+r+z)^t} \right) \right) \right]$$

$$E(V_1) = \sum_{p=0}^{m} \sum_{t=4^p}^{4p+p} \frac{1}{(m+1)2^p} \left[\left(\binom{p-1}{k} \left(\frac{\Pi_{1 \cdot t+1}}{(1+r+z)^{t+1}} \right) \right) + \left(\binom{p-1}{k-1} \left(\frac{\Pi_{2 \cdot t+1}}{(1+r+z)^{t+1}} \right) \right) \right]$$

where

t = month into the future where t can assume any integer value 0, 1, 2, 3, . . .

r = interest rate for discounting future returns to the present.

z = uncertainty premium or probability of a significantly incorrect estimate of profit.

$m+1$ = number of feeding periods in the planning horizon.

p = future feeding periods with p assuming the values of 0 for the present period and 1, 2, 3, $\cdots m$ for feeding periods into the future.

$k = 0, 1, 2, \cdots p$ as $t = (4p), (4p+1), (4p+2), \cdots (4p+p)$.

$$\binom{p-1}{k}^1 = \left[\begin{array}{l} 1, p = k = 0 \\ 0, k = p, p > 0 \\ \binom{p-1}{k}, p > 0, 0 < k < p \end{array} \right. \qquad \binom{p-1}{k-1}^1 = \left[\begin{array}{l} 0, p = 0 \\ 0, k = 0 \\ \binom{p-1}{k-1}, p > 0, \\ \qquad 0 < k < p \end{array} \right.$$

$E(V_0)$ = expected value of planning horizon from marketing in present month.

$E(V_1)$ = Expected value of planning horizon from marketing one month in the future.

The factor 2^p gives the possible combinations of 4-or-5-month feeding periods leading to marketings of hogs in months $t(t=4p$ to $4p+p)$ from the pth feeding period. This holds true for $p=0,1,\cdots,m$. The factor $1/(1+r+z)^t$ discounts expected net profits for both the present value of future profits (r) and the decreasing reliability of profit estimates as time into the future increases (z). The symbol $\binom{p-1}{k}$ gives the number of combinations of 4- or 5-month feeding periods leading to the possible marketings of 4-month fed hogs in each of the $4p$ to $4p+p$ $(k=0,\cdots,p)$ months. The symbol $\binom{p-1}{k-1}$ gives the corresponding number of combinations leading to 5-month fed hogs marketable in the pth feeding period.[1] The factor $1/(m+1)2^p$ assigns equal weight to the 2^p possible combinations of 4- and 5-month periods leading to marketings in the pth period and maintains the sum of the weights equal to 1 for any value of m.

For model illustration purposes, assume computation of the expected value of marketing in the present month using a planning horizon of two feeding periods into the future. By substituting $(d)^t=(1+r+z)^t$ the expected value of marketing in the present month becomes:

$$E(V_0)=\left[1/3\ \Pi_{1\cdot 0}\right]+\left[1/6\ \frac{\Pi_{1\cdot 4}}{(d)^4}\right]+\left[1/6\ \frac{\Pi_{2\cdot 5}}{(d)^5}\right]+\left[1/12\ \frac{\Pi_{1\cdot 8}}{(d)^8}\right]$$
$$+\left[1/12\ \frac{\Pi_{2\cdot 9}}{(d)^9}\right]+\left[1/12\ \frac{\Pi_{1\cdot 9}}{(d)^9}\right]+\left[1/12\ \frac{\Pi_{2\cdot 10}}{(d)^{10}}\right]$$

The expected value of marketing one month in the future $[E(V_1)]$ would then be compared to this value to determine the month yielding the highest expected value.

A computer simulation program was developed and run to compare continuous sequences of fixed lengths (4 and 5 months) with the variable length model. Four-month fed hogs were assumed to weigh 220 pounds and to have production costs of \$15.00 per hundredweight. Five-month fed hogs were assumed to weigh 270 pounds and to have production costs of \$15.25. Hogs were priced using monthly price data for U. S. Grades 1–3 hogs during the 1956–67 period. Decisions were made at the appropriate 4- and 5-month intervals. The most profitable planning horizon using this set of data was found to be 6 periods. Profits were compared assuming a 6-period planning horizon and 400 hogs on feed at all times. Profits per month using the decision model were \$582.40 compared with \$551.45 per month for the continuous sequence of 4-month periods and \$374.62 per month for the sequence of 5-month periods.

The general decision model is adaptable or modifiable in several respects. The 2-month flexibility period was chosen for simplicity only; the model will accommodate any flexibility period by substituting the desired period for months. Variations of the model permit net revenue maximization by those with varying degrees of risk aversion as well as with differing abilities to predict future prices. The model is equally adaptable to study marketing decisions for other livestock, such as cattle and sheep.

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[1] This is the normal combinatorial symbol where exceptions are defined for values of p and k for which the normal symbol would be undefined.

Implications

The model permits adjustments in the length of feeding in the present period that are brought on by expected price changes in the future. If prices in the medium-to-late planning horizon are expected to peak and begin to descend, the model will initially encourage longer feeding of each production cycle and then shorter feeding periods as the price peak is passed. This places more pork on the market at the expected peak prices (through heavier weights) while less pork is marketed as the expected price descent begins. Thus, the model will tend to encourage contracyclical production. If reliable and reasonably accurate estimates can be made of future prices for live hogs, it is hoped that the proposed model can work to smooth the cycle and stabilize production at profitable price levels for most producers.

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A Game Theoretic Model for Farm Planning Under Uncertainty*

MAHFOUZ E. TADROS AND GEORGE L. CASLER

UNCERTAINTY has long been recognized as an important aspect of farm planning. It was only recently, however, that different approaches to the problem of uncertainty in farm planning have been suggested [2, 5, 6, 7, 9]. These approaches employed techniques such as dynamic programming, game theory, quadratic programming, simulation, and stochastic linear programming. The game approach suggested by McInerney [5] was the first attempt that we have found in the farm management literature to incorporate farm constraints in a game against nature. McInerney's model, however, provides solutions only for the Wald maximin criterion. Decision criteria other than the Wald maximin may be more appealing to some farmers. This paper presents a model that incorporates farm constraints in a game against nature in a different manner from that of McInerney's model. The proposed model enables a farmer to obtain solutions for the maximin criterion and other decision criteria.

The Model

Decision making under uncertainties in factors such as weather could be specified in the form of games against nature [4]. Thus, one can conceive of a farm planning problem as a farmer game against nature.

A game against nature has three basic components, states of nature, alternative courses of action (decision maker's strategies) and a payoff matrix. The proposed model is a game against nature; the elements of this game are specified in the following pages.

The states of nature for this game represent different possible combinations of gross margins of the farm activities (activities in the linear programming sense) which might occur in the planning period ahead. Thus, each state of nature is characterized by different production and price conditions. Let us assume n states of nature are possible in the next planning season, namely, $S_1, S_2 \cdots S_j \cdots, S_n$, where n is a finite number.

The farmer's strategies, for this game, are defined by various combinations of farm activities (farm plans). These farm plans are derived by linear programming. A deterministic linear programming model for planning farms is developed for this purpose:

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* The comments of K. L. Robinson and B. F. Stanton on an earlier draft are sincerely appreciated.

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$$\text{Maximize} \quad \sum_{j=1}^{N} c_j x_j$$

$$\text{Subject to} \quad \sum_{j=1}^{N} a_{ij} x_j \leq b_i \qquad \text{for all } i \ (i = 1, 2, \cdots, M)$$

$$x_j \geq 0$$

where

c_j = the gross margin per unit of the jth activity, $(j = 1, 2, \cdots, N)$

x_j = the level of the jth activity, $(j = 1, 2, \cdots, N)$

b_i = the quantity of the ith resource (or activity constraint) available (or allowed) to the farm, $(i = 1, 2, \cdots, M)$

a_{ij} = the quantity of the ith resource (or activity constraint) required by one unit of the jth activity i.e. input—output coefficient, $(i = 1, 2, \cdots, M; j = 1, 2, \cdots, N)$.

To define a particular strategy for this game, let us assume that a given state of nature (say S_j) is going to prevail next season. The question then arises as to what combination of farm activities (farm plan) should the farmer adopt in order to maximize his returns. Our definition of a state of nature for the game model is the same as the objective function for the linear programming model (i.e. the gross margins of the farm activities). Thus, the gross margins associated with a given state of nature (say S_j) could be used as the objective function for the linear programming model. Solving this linear programming problem provides the farmer with an optimal farm plan for the S_j state of nature, if one exists. Let X_i denote that optimum farm plan where X_i is a vector of farm activities $(x_1, x_2, \cdots x_j, \cdots, x_n)$. This optimum combination of farm activities (X_i) is one of the strategies for the game model. Other strategies are defined for each state of nature in the same manner. Thus, n linear programming problems have to be solved to define the strategies for the game model. Let m designate the total number of defined strategies, where m is a finite number. A particular state of nature could have more than one optimal farm plan. It is also possible that a particular farm plan could be optimal for more than one state of nature. Therefore, the total number of strategies (m) could be greater than, equal to, or less than the total number of states of nature $(m \gtreqless n)$.

The payoff elements for the game are the values of the various strategies $(X_1, X_2, \cdots X_i, \cdots, X_m)$ under the different states of nature $(S_1, S_2, \cdots, S_j \cdots, S_n)$. Let o_{ij} represent the payoff (outcome) to the farmer if he plans strategy X_i and the S_j state of nature prevails, where X_i is optimal for S_j. This payoff (o_{ij}) is the value of the objective function that results from solving the linear programming problem using the gross margins of S_j. Now assume that the farmer had planned strategy X_i but S_k prevailed, where $k \leq n$ and $k \neq j$. The payoff to the farmer in this case is the value of X_i with the gross margins of the state S_k. Let this payoff be designated by o_{ik}, where o_{ik} could be greater than, equal to, or less than o_{ij} ($o_{ik} \gtreqless o_{ij}$). The same relation could hold for the gross margins of any farm activity in both states (S_k and S_j).

Let us formulate the payoff matrix for a special case of this game. It is assumed, for this special case, that each state of nature has only one optimal strategy and each strategy is optimal for only one state of nature. This assumption results in as many strategies as states of nature, i.e., $m = n$. Thus, the payoff matrix is a square matrix and could be presented as:

$$\begin{array}{r|lllll}
 & \multicolumn{5}{c}{\text{States of nature}} \\
 & S_1 & S_2 \cdots & S_j \cdots & S_k \cdots & S_n \\
\hline
X_1 & \boxed{o_{11}} & o_{12} \cdots & o_{1j} \cdots & o_{1k} \cdots & o_{1n} \\
X_2 & o_{21} & \boxed{o_{22}} \cdots & o_{2j} \cdots & o_{2k} \cdots & o_{2n} \\
\cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
\text{Farmer's } \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
\text{strategies } X_i & o_{i1} & o_{i2} \cdots & \boxed{o_{ii}} \cdots & o_{ik} \cdots & o_{in} \\
\cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
X_k & o_{k1} & o_{k2} \cdots & o_{kj} \cdots & \boxed{o_{kk}} \cdots & o_{kn} \\
\cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
X^m & o_{m1} & o_{m2} \cdots & o_{mj} \cdots & o_{mk} \cdots & \boxed{o_{mn}}
\end{array}$$

Each of the diagonal elements of this payoff matrix represents the highest payoff that the farmer could obtain if the state of nature corresponding to a given diagonal element prevails. This implies that none of the strategies defined is dominated by any other strategy i.e., none of the rows is an inferior row. This feature holds for the general case (i.e., $m \gtreqless n$), except under the unlikely situation where there exist more than one optimal plan for a particular state, and one of those plans is dominated by another plan also optimal for that state.

Once the payoff matrix is formulated, the farmer may select a farm plan (or a linear combination of two or more farm plans) that corresponds best with his objectives, attitudes and financial obligations. Various decision criteria, including the Wald maximin [4], Savage regret [4], Hurwicz [4], benefit [1], and Laplace [4], have been suggested to help the decision maker choose among his strategies. Each of these decision criteria implies different objectives or psychological characteristics of the decision maker. Both pure and mixed strategy solutions are allowed in this game. A mixed strategy solution specifies a linear combination of two or more strategies. Mixed strategies could be derived by linear programming [3].

The framework of the proposed model provides the farmer with useful means for identifying the main components of this decision problem. It also allows for a meaningful consideration of the pros and cons of alternative farm plans. In addition, the game approach can be easily rationalized and its results can be presented in a simple format. The proposed model also has the advantage of using a standard linear programming computer code that is readily available.

The proposed model has been applied to a cash crop farm in New York State [8]. Both yield (or technical) uncertainty and price uncertainty were considered. Twenty-two states of nature were identified for the game. The gross margins of these states were derived from time series data. Solutions were derived for seven decision criteria. It was noted that the maximin solution derived by the model proposed in this paper and that obtained by McInerney's model [5] were exactly the same for this farm. This, however, should not imply that the two models would result in the same solution in other cases.

Perhaps a crucial part of this model is the definition and specification of the states of nature. If the states of nature are defined so that their probabilities can be determined, the Bayesian approach could be incorporated in the model.

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Application of Linear Programming to Individual Farm Planning

DONALD C. HUFFMAN AND LYNN A. STANTON

The Problem

FARMERS, Farm Management Extension personnel, and farm organization leaders are interested in the possibility of using computers for assisting in making management decisions for individual farm situations. Private farm management firms tend to be more interested in providing a farm management service while some of the Extension personnel are more interested in the service as a catalyst for educational programs with farmers. The relatively high cost of programming a resource situation and the difficulty of defining precision input-output relationships have retarded the adoption of these techniques for extension work with farmers.

A research study at Louisiana State University was designed to explore the similarities in farm organization when short cuts were taken in the linear programming process by (1) using standardized input-output coefficients, such as would be available in a data bank; and (2) by using a simplified programming matrix, which included only key resource restraints and production activities based on the experience of professional farm management specialists. A second phase was designed to evaluate the range of farm organizations for which income levels approximated that obtained with optimal organization. The primary purpose was to determine whether relatively low cost linear programming solutions were sufficiently accurate to be offered as a management service to farmers.

We began with the assumption that a detailed linear programming model utilizing the farmer's input-output data is both too costly and too time consuming to have widespread acceptability among farmers. A second limitation of this procedure is the lack of sufficient data to estimate many of these relationships for the individual farm.

If we can obtain basically the same farm organization using "standards" or "norms" that we get with the "best estimate," the cost per farm could be reduced considerably. Given a set of structural models, a data bank, the primary resource restraints and potential production activities, relatively low cost personnel, using routine procedures, could select the appropriate model and input-output coefficients.

A reduced size model would require the services of trained specialists

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familiar with the farm situation to structure the production alternatives and resource restraints. However, the planning job could be performed in no more time than would normally be spent in "budgeting" a farm situation. A larger number of variations in the plan could be considered than would be likely with budgeting procedures. This type model could improve the effectiveness of the farm management specialist, if satisfactory solutions can be obtained at a reasonable cost.

If a range of alternative organizations exist which provide income levels near that achieved by the optimum organization, the less precise techniques may provide acceptable organizations even though they may not be "the optimum" organization. A range of near optimum organizations may be of more importance than identifying the optimum. This has particular relevance when considering managerial preferences.

The Procedures

Three farm resource situations were selected for case studies, representing varying degrees of complexity in terms of feasible production alternatives. A detailed matrix (approximtely 60 × 60) was developed for each farm situation. The matrix structure and coefficients included were developed from data obtained from the farm managers during a number of intensive interviews. The solutions for these models were then used as the best estimate of the optimum organization for each of the respective farm situations.

A second matrix (structurally the same as the first) was developed for each farm situation using the type input-output coefficients that could be maintained in a data bank.

A third matrix (approximately 20 × 20, or less) was developed for each farm situation. Resource restraints and production alternatives were more aggregative and less inclusive than for the detailed models. A priori decisions by the farm planner provided the basis for eliminating production alternatives, options within alternatives, and resource restraints. (This model is also adapted to standardized coefficients.)

The coefficients for the standardized detailed model and both the coefficients and structure of the reduced size model were probably more tailored to the individual farm situation than would be expected within the framework of a farm planning service, because of the bias of a priori knowledge acquired by the farm planner during the intensive interviews with the farm managers.

A number of modifications of resource restraints and production activities were imposed upon each of the "best estimate" matrices to develop a range of alternative organizations for each farm resource situation. This was done to evaluate the degree of accuracy for acceptable solutions.

Results

The farm organizations determined using standardized coefficients deviated considerably from those determined using the best estimate coefficients. They deviated in terms of enterprises included, quantitities of enterprise included, and production practices within enterprises. In general, these solutions were unacceptable for all resource situations.

A superficial inspection of the results from the reduced size models suggested considerable similarity in organization to that obtained with the detailed best estimate model. However, the production practices assumed in the smaller model were not consistent with those selected in the detailed model, the choice of feed grains to produce was not consistent, and the mix of feed grains and soybeans included was not consistent. The choice of combinations of these enterprises was highly interrelated with the production practices utilized. The deviations were greater for the more complex resource situations. Thus, the solutions from these models were unacceptable in terms of similarity in farm organization.

Changes occurring in farm organization due to changes in the resource restraints imposed on the model were predictable. Approximately 30 variations in the restraints were imposed on the model for the most complex resource situation. These included some rather severe limitations simulating managerial preference. Approximately 20 percent of the solutions yielded net income levels within 6 percent of the income for the optimum and about 40 percent yielded net income levels within 12 percent. About 80 percent of the solutions were within 20 percent. A wide range of organizations were included within both the 6 percent and 12 percent ranges. The most drastic reductions in income were caused by eliminating or imposing arbitrary maximum limits on high value enterprises.

Implications

The results of this study provide little optimism for the direct use of linear programming as a farm management service. The solutions obtained from the reduced size matrix are probably neither more nor less acceptable than budgeing solutions. A fairly wide range of alternatives appears to be acceptable by a net income criterion, considering our limitations for accuracy in coefficient determination. The question remains: "Will the benefits derived from utilizing 'optimum linear programming solutions' from a reduced size matrix in a farm management program justify the costs associated with providing a linear programming service to farmers?" The benefits will be greater if the farmer is provided a package of solutions for evaluation rather than a single optimum solution.

There is a note of optimism for indirect use of linear programming in farm planning. The manipulation of restraints on the more detailed models provided considerable insights into the factors affecting farm organization. There may be considerable merit in developing data banks (if sufficient stratification is provided) and using these to update a series of solutions for selected benchmark farm situations. A study of the results from a series of solutions can be a valuable aid in determining what alternatives to consider in a budget analysis for a particular farm situation, what factor(s) affect a particular choice, and the kind of effect the factor(s) have on a particular choice. This endeavor would be expensive, but we believe it could be justified if emphasis is to be placed on providing farmers with intensive assistance in management decisions.

Farm Capital and Credit Projections to 1980

EMANUEL MELICHAR

WITH the approach of a new decade, several projections of farm capital in 1980 have appeared. Conceptually, such long-run capital projections ought to be particularly useful to agencies that can influence the volume and terms of credit available to agriculture. For instance, availability of bank credit might be increased by developing secondary markets for farm loan paper, improving access of rural banks to discount facilities of the Federal Reserve Banks and Federal Intermediate Credit Banks, or promoting branch banking. Such efforts are more likely to be seriously pursued if greater future credit demands can be well documented.

Unfortunately, most capital studies have not served this purpose. Common shortcomings and omissions are discussed below, along with some thoughts that may help point the way to improved work. Throughout, one recently published projection is used simply to provide an empirical example of the considerations discussed, not because it is necessarily better or worse than other available projections.

Capital Stocks

The National Advisory Commission on Food and Fiber sponsored a study to "get the best possible estimate of the resources and farm structure needed to produce food and fiber in 1980" [1, p. iii]. From several projections of 1980 capital stocks made in that study, the Commission chose to present the "feed grain model" in which the 1980 stock of real estate, machinery, and livestock was projected at $275.6 billion "in 1965 dollars," up from $200.9 billion in 1965. This "suggests that the total value of capital employed in agriculture will increase by 35 to 40 percent in 1980" [2, p. 240].

As physical quantities of farm assets rose by only about 11 percent during the preceding 15 years of great agricultural change, this was an exciting projection. Thus, what a letdown to find that a unique concept of "1965 dollars" had been employed. The machinery and livestock projections did refer to physical quantities, but two-thirds of the projected gain in total capital reflected only the land price appreciation that would occur if projected increases in rents (in 1965 dollars) were capitalized into land prices at the 1965 capitalization rate. This partial estimate of land price

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inflation was added to the projected real increases in machinery and livestock to get a total that represents—what?

If stability in physical real estate assets is projected—an expectation consistent with the relatively insignificant growth experienced since 1955—the adjusted 1980 projection for the three assets in 1965 prices totals $225.9 billion, an increase of only 12 percent during 1965–80 (Table 1, part B).

But a projection in truly real terms remains of limited value to those concerned with capital requirements and credit demands. In 1950, for example, how helpful would it have been to have had perfect foreknowledge of the 11 percent real increase that was to take place by 1965—but not to have known that current-dollar stocks would double and aggregate credit demands triple?

Table 1. Past and projected farm capital stocks (billions of dollars)

Type of asset	1950	1965	1980
A. Heady-Mayer "feed-grain model" projection for 1980			
Land and buildings			210.5
Machinery and equipment			43.3
Livestock inventories			21.7
			275.6
B. Actual values and adjusted Heady-Mayer projection (1965 dollars)			
Land and buildings	148.3	160.9	160.9
Machinery and equipment	18.4	25.5	43.3
Livestock inventories	12.2	14.5	21.7
	178.9	200.9	225.9
C. Actual values and adjusted Heady-Mayer projection (current dollars)			
Land and buildings	75.3	160.9	283.3
Machinery and equipment	12.2	25.5	62.7
Livestock inventories	12.9	14.5	21.7
	100.4	200.9	367.7

The general price level has on average been rising by 2 percent annually since 1950, further increases are generally expected, and several studies have indicated a proportional response in land prices. This prospective contribution to land price inflation might be added to the rent capitalization effect already in the model. Also, farm machinery prices have exhibited an average annual increase of 2.5 percent since 1950, and a continuation of this rate might be projected. With these crude but plausible price adjustments, projected 1980 current-dollar stock becomes $367.7 billion, up 83 percent from 1965 (Table 1, part C).

Capital Flows

Capital flows, rather than changes in stocks, constitute the capital requirements that must be financed and can lead to credit demands. Flows can be much different from the changes in stocks, if any, that accompany them. Flows may be defined as capital required for (1) replacement of buildings, land improvements, and machines that wear out or become obsolete; (2) physical additions to the stock of land, land improvements, buildings, machinery, livestock, stored crops, and working capital; and (3) transfer of real estate by sale rather than inheritance [3, p. 134].

USDA estimates provide annual data on all past capital flows except real estate transfers. But this data gap can be approximately filled by using new USDA data on the value of farms sold in 1965–67 plus some heroic assumptions, enabling complete capital flows to be estimated. Annual requirements fluctuated around $8 billion in the late 1950's and early 1960's but rose to $11 billion in 1965–67, as machine stocks were increased and land price inflation accelerated (Table 2).

Table 2. Average annual farm capital flows (billions of dollars)

Type of capital requirement	Estimated actual				Projected—feed grain model		
	1950–54	1955–59	1960–64	1965–67	1965–69	1970–74	1975–79
Gross capital expenditures:							
Machinery	3.1	2.8	3.2	4.6	5.1	7.0	9.4
Buildings, etc	1.5	1.4	1.3	1.3	1.3	1.3	1.4
To increase:							
Livestock inventory	.5	.1	.3	0	.4	.5	.5
Stored crop inventory	.1	.2	0	.4	.1	.1	.1
Working capital	.1	−.1	0	.3	.1	.2	.2
Real estate purchases	2.5	3.0	3.5	4.4	4.5	5.4	6.5
Total	7.8	7.4	8.3	11.0	11.5	14.4	18.1

Given a projection of farm capital stocks that shows its real and price inflation components, together with projected depreciation and real estate transfer rates, the implied capital flows can be derived. Capital flows under the adjusted feed grain model are estimated to rise to an annual average of $18.1 billion in 1975–79, up 118 percent from the average level 15 years earlier (Table 2).

Credit Demands

Projection of capital flows is but a first step toward estimation of credit demands, that is, of net changes in farm debt. Minimum further needs are

Table 3. Sources of capital (annual average billions of dollars)

	Estimated actual				Projected—feed grain model		
	1950–54	1955–59	1960–64	1965–67	1965–69	1970–74	1975–79
Cash flow							
(A) Depreciation allowances	3.2	3.9	4.4	5.3	5.6	7.5	9.4
(B) Net farm income	14.8	12.7	13.7	16.2	15.7	17.2	18.8
(C) Farm cash flow	18.0	16.6	18.1	21.5	21.3	24.7	28.2
(D) Nonfarm income	6.4	6.6	8.1	10.4	10.7	13.7	17.5
(E) Total cash flow	24.4	23.2	26.2	31.9	32.0	38.4	45.7
Sources—Model I							
(F) From farm cash flow	6.8	6.0	5.7	6.7	6.6	7.7	8.7
(G) Increase in debt	1.0	1.4	2.6	4.3	4.9	6.7	9.4
(H) Capital requirements	7.8	7.4	8.3	11.0	11.5	14.4	18.1
(F) as percent of (C)	38	36	31	31	31	31	31
Sources—Model II							
(I) From total cash flow	6.8	6.0	5.7	6.7	6.7	8.1	9.6
(J) Increase in debt	1.0	1.4	2.6	4.3	4.8	6.3	8.5
(H) Capital requirements	7.8	7.4	8.3	11.0	11.5	14.4	18.1
(I) as percent of (E)	27	26	22	21	21	21	21

projections of farm income and of the relative distribution of capital financing among income, depreciation allowances, and debt—all consistent with the capital projection. Ideally, all projections would be the output of a model in which the capital, income, and savings equations are jointly developed. Here, a crude procedure will be used to illustrate the considerations involved and perhaps inspire more sophisticated future efforts.

First, depreciation allowances consistent with projected machinery and building stocks are calculated. In the adjusted feed grain model, allowances rise rapidly because of the large buildup in the real machine stock. Second, to project net farm income, we might assume that in the long run countervailing political forces will keep growth in real per farm income roughly parallel to growth in national real per capita income, which the National Planning Association has projected at 3.25 percent annually for 1965–80. If in addition the general price level rises by 2 percent and farm numbers decline by 3.3 percent annually, aggregate net farm income would advance by 1.84 percent yearly. Annual farm cash flow—the sum of depreciation allowances and net farm operator and landlord income—would then average $28.2 billion in 1975–79, compared with $21.5 billion in 1965–67 (Table 3, line C).

Next, how have capital flows been financed in recent years? We know the past increase in debt; by subtracting it from the estimated total capital outlays, we obtain a sum that we can regard as financed from farm

Table 4. Farm debt

	Estimated actual				Projected—feed grain model		
	1950–54	1955–59	1960–64	1965–69	1965–69	1970–74	1975–79
Average annual increase in debt (billions of dollars)							
USDA estimate	1.0	1.4	2.6	4.5			
Projected—feed grain Model I					4.9	6.7	9.4
Projected—feed grain Model II					4.8	6.3	8.5
Outstanding debt at end of period (billions of dollars)							
USDA estimate	17.6	24.8	37.6	61.1			
Projected—feed grain Model I					62.2	95.8	139.5
Projected—feed grain Model II					61.5	93.2	135.7
Average annual growth rate of outstanding debt (per cent)							
USDA estimate	7.3	7.1	8.7	10.2			
Projected—feed grain Model I					10.6	9.0	7.8
Projected—feed grain Model II					10.4	8.6	7.8

cash flow. On an average annual basis, capital flow requirements in 1965–67 were $11.0 billion and the increase in debt was $4.3 billion; thus $6.7 billion was financed from cash flow. This amount was 31 percent of farm cash flow of $21.5 billion.

Suppose that this rate of internal savings continues. Then in 1975–79, for example, 31 percent of farm cash flow, or $8.7 billion annually, would be applied toward total annual capital outlays of $18.1 billion. Therefore, the remaining annual outlays of $9.4 billion must be financed by increase in debt (Table 3, Model I).

Alternatively, perhaps farmers' nonfarm income should be included in cash flow (Table 3, line E). Similar calculations show that farmers have recently been applying about 21 percent of total cash flow toward capital requirements. If this savings rate is projected, and nonfarm income continues to rise at the 1957–67 annual average of 5 percent, slightly lower estimates of future growth in debt are obtained. Annual increases would average $8.5 billion in 1975–79 (Table 3, Model II).

These models project farm debt outstanding in 1980 at $140 and $136 billion, respectively. They indicate a slowing in the rate of increase of outstanding debt from recent annual rates of 10 percent to around 8 percent a decade later (Table 4).

Observe that many steps beyond the capital projection were required to obtain the projection of credit demands desired by policymakers. Suppose that additional work enabled monetary authorities to project annual deposit growth averaging 5 percent at rural banks. Given the above credit demand projections, the authorities would be concerned about the ability of rural banks to maintain their relative share of the farm credit market.

But the prevalence of assumptions in the above projections indicates their insecure foundation. More analytical work is sorely needed, and it should include the often neglected considerations discussed herein. Hopefully, it will be possible to build structural models in which these interdependent financial variables are jointly determined.

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A Method for Analyzing the Effect of Taxes and Financing on Investment Decisions

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ONE of the critical problems faced by those who contemplate investments is the effect of taxes and finance charges on investment decisions. While it is known that these costs reduce the expected annual return available for retiring the investment cost, there is at present no readily applicable method of taking this known reduction into consideration in the decision process. This paper develops a method by which taxes, investment credit, and financing charges can readily be included in the decision model. A more meaningful economic appraisal of investments results. At the outset the requirement is made [1] that:

$$(1) \qquad I \leq V_0 = \sum_{t=1}^{k} \frac{E_0(Yt)}{(1+r)^t} + \frac{E_0(Mk)}{(1+r)^k},$$

where

I = the investment cost,
V_o = the value of the investment to the operator at t_o,
$E_o(Y_t)$ = the expectation at t_o on income to be generated in t,
$E_o(M_k)$ = the expectation at t_o on the value the market will generate for the asset in year k,
r = the rate used to discount expected income and market value,
t = unit of time, and
k = the number of years the asset is expected to be used.

Equation (1) can be thought of as an investment decision model in which future income and the future market value are compared with the investment cost.

Missing from equation (1) are the elements necessary to quantify the effect of borrowed money and the effect of taxes on the value of the investments. These factors can be incorporated into equation (1) without unduly complicating the arithmetic involved.

Finance charges can be incorporated by adding:

$$\sum_{t=1}^{j} \frac{C_t}{(1+r)^t},$$

where

C_t = the yearly financing charge;
j = the number of years the payments are to run.

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The modification necessary to include income taxes in equation (1) is:

$$\sum_{t=1}^{k} \frac{E_0(Y_t)(1 - Tr)}{(1 + r)^t},$$

where $Tr =$ the tax rate used to compute the income tax liability.

To reflect the investment credit provision, equation (1) is modified as with:

$$\sum_{t=1}^{i} \frac{Ic}{(1 + r)^t},$$

where

$I_c =$ the investment credit,

$i =$ the number of years the credit is carried.

In the decision model, if $k \geq 8$ the investment credit is allowed in its entirety. For $k < 8$ only a portion of the credit is allowed: if $k \geq 4 < 6$, the credit is 33 1/3 percent; and if $k \geq 6 < 8$, the credit is 66 2/3 percent [2].

The potential effect of capital gains must also be considered. A capital gain occurs when the sale value exceeds the investment cost adjusted for depreciation. For the individual the tax on capital gains can be paid one of two ways: (1) he can exclude one-half of the gain and pay tax at the ordinary rate on the remainder, or (2) he can pay tax at the rate of 25 percent on the entire amount. The effect of the capital gains can be handled by modifying the last term of equation (1).

$$\frac{\left[I - \sum_{t=1}^{k} D_t - E_0(M_k)\right](1 - Tc)}{(1 + r)^k}$$

where

$D_t =$ the annual amount of depreciation

$T_c =$ the tax rate on capital gains.

The modified decision model now appears as:

$$V_0 = \sum_{t=1}^{k} \frac{E_0(Y_t)(1 - Tr)}{(1 + r)^t} - \sum_{j=1}^{j} \frac{C_t}{(1 + r)^t} + \sum_{t=1}^{i} \frac{Ic}{(1 + r)^t} + \frac{\left[I - \sum_{t=1}^{k} D_t - E_0(M_k)\right](1 - Tc)}{(1 + r)^k}. \tag{2}$$

Using equation (2) as a basic equation, the required annual increment can be determined with:

$$E_0(Y) = \left\{ \left[I + \sum_{t=1}^{j} \frac{C_t}{(1+r)^t} - \sum_{t=1}^{i} \frac{Ic}{(1+r)^t} + \frac{\left[I - \sum_{t=1}^{k} D_t - E_0(M_k) \right](1 - Tc)}{(1+r)^k} \right] \frac{r}{1-(1+r)^{-k}} \right\} \frac{1}{(1-Tr)}, \tag{3}$$

where $E_o(Y)$ is the minimum annual return required to retire the investment cost in k years after adjustment for taxes.

The expected value remaining to be recovered if the asset is disposed of after k years of use is determined by:

$$I - \sum_{t=1}^{i} D_t - E_0(M_k) = \left\{ \left[I - \sum_{t=1}^{k} \frac{E_0(Y_t)(1-Tr)}{(1+r)^t} - \sum_{t=1}^{i} \frac{Ic}{(1+r)^t} + \sum_{t=1}^{i} \frac{C_t}{(1+r)^t} \right] (1+r)^k \right\} \frac{1}{(1-Tc)}, \tag{4}$$

where

$$I - \sum_{t=1}^{k} D_t - E_0(M_k)$$

is the tax adjusted expected value remaining to be recovered at any year k.

The effect of the taxes and financing charge, using a cattle feeding system to illustrate the decision model implied in equation (1), is shown in Table 1. The investment cost was \$112,264 of which \$75,000 was financed to be repaid in 5 years with interest at 7 percent of the remaining balance. Investment credit was carried forward according to the yearly tax liability. Equation (3) is used to calculate the required annual increment shown in Tables 1 and 2. The consideration of all costs in the investment decision reduces the economic feasibility of an investment by (1) extending the period required to recover the investment cost and (2) decreasing the allowable rate that can be used for discounting. The magnitude of these expected effects is great enough to demonstrate that, if adequate investment evaluation is to be made, the investor needs to make good estimates

Table 1. Annual required increment for an investment of \$112,264 when taxes and financing charges are included as costs

r \ k	Annual required increment			
	6	7	8	19
6	29,786	27,141	22,985	13,267
15	38,939	34,189	32,152	24,064

Table 2. Annual required increment when only taxes are considered as a cost and when neither taxes nor financing is included

r \ k	Annual required increment			
	6	7	8	19
6	27,032	23,834	20,824	12,012
15	35,391	32,191	29,160	21,807
	Annual required increment with no taxes or financing			
6	22,830	20,111	18,079	10,118

of the added costs that result when investments are to be made in income generating assets.

In Table 2 the required annual return is shown when only taxes are considered. The effect of both taxes and financing can be seen by comparing Tables 1 and 2. When *k* is less than 8, the investment credit offsets a part of the tax liability, lessening the effect of taxes on the required return. The effect of the credit diminishes as *k* increases.

The decison model presented in this paper provides insights into the importance of taxes and finance charges in investment evaluations. The analysis demonstrates that not including taxes and finance charges would overestimate the repayment capabilities of the investment for any specified expected use period. Overestimating the repayment ability could lead to a loss to the decision maker if the expected value remaining to be recovered is subject to test in the market before the end of the expected use period. The method is flexible in that any part of the costs that do not pertain can be dropped without altering the remainder of the equations.

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ECONOMICS OF ENVIRONMENTAL CONTROL

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Economic Issues in Controlling Agricultural Pollution*

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OUR present problems of environmental pollution result from more intensive use of our natural resources and from slow rates of collective adjustment to rapid technological changes. They also result from rapidly rising standards of environmental quality demanded by a better educated, better informed, more affluent, and more mobile population. Environmental pollution may be defined as those interactions of men with their physical surroundings that result in diminished levels of well-being. This definition emphasizes the importance of changes in perception of the observers as well as changes in the characteristics of the physical environment. Thus, pollution problems result from changes in the presence or perception of the "victims" as well as from changes in the activities of the "pollutors."

Discussion, controversy and confusion concerning pollution of our physical environment has risen sharply in the past few years. Increasing anxiety about pollution among the general public is leading to actions through all levels of government. The agricultural industry and rural people are directly involved in their roles as both pollutors and victims of pollution. However, the major issues involved are much broader than agriculture alone, and the problems of agricultural pollution can seldom be considered in isolation from the general problems of environmental quality.

The objectives of this paper are: (1) to stress the multiple decision-making aspects of controlling environmental pollution; (2) to highlight a number of significant economic issues involved; and (3) to suggest some significant areas where economic research can contribute to reduction of agriculturally related pollution.

Agriculturally Related Pollution—The Problem Areas

The agriculturally related pollutants now considered problems are pesticides, animal wastes, sediment, plant nutrients, inorganic salts and min-

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erals, forest and crop residues, agricultural processing wastes, and smoke, dusts and other air pollutants [9]. The discussion of pesticide residues is particularly audible at the moment. The persistent chlorinated hydrocarbons are of major concern. Several states have imposed or are considering spray bans or other stringent controls on the use of persistent pesticides.

Animal waste production is approximately two billion tons per year. Roughly half of this waste is associated with concentrated livestock production. This problem is expected to become more serious as economies of livestock production are exploited through fewer and larger operations and as cheaper chemical fertilizers more completely replace the use of animal manures.

Sediment is our largest single pollutant of surface waters. Approximately a billion tons reaches major streams annually. Sediment is important as a carrier of plant nutrients, pesticide residues and infectious agents.

Plant nutrients from soils, animal wastes, and fertilizers have contributed to locally serious problems of excess aquatic growth (eutrophication) and nitrate contamination of ground water supplies. Saline irrigation drainage waters are an important problem in arid areas.

The high organic content of forest and crop residues and agricultural processing wastes is a major problem in many areas. Low utilization values present solid waste disposal problems. Burning may create air pollution. Serious water pollution can result from placement or wash into surface waters.

Decision Making for Environmental Management

Decisions on environmental management are made by millions of individuals and organizations. Optimum patterns of environmental management require that these decisions be directly or indirectly coordinated. The difficulties of achieving coordination are enormous. Objectives are multiple and conflicting. Information is limited. Decisions are sequential and constrained. Furthermore, our political economy and social value systems have so evolved as to make it relatively easy to mobilize sufficient power to effect rapid technological changes. But at the same time it is more difficult to launch efforts of similar force and speed to attack pressing social problems that may result from ongoing technical changes.

I propose to highlight a number of economic issues within a three-tier hierarchy of decision-making levels [4]. These levels are: first, the individual or firm; second, the bureaucratic and legal systems that operate to facilitate and constrain decisions at the first level; and topmost, the arenas of the legislatures, the commissions, the high courts, and even the industry board rooms where broad decisions affecting the second level framework are made.

Decision Making in the Legislative Arenas

Much of the present turmoil over environmental quality results from inadequate representation of the perceptive pollution "victims" in the political decision-making process. These "third parties" are currently being represented to a large extent in the national communications media. What is a socially desirable and economically efficient means for their representation within the political process? Citizen advisory groups? Scientific advisory boards? Court actions?

What level of government should assume responsibility for control of specific environmental problems? Involved are the specific instruments appropriate for program action—taxation, subsidy, education, regulatory powers; the representation of concerned parties; and the capability to build effective bureaucracies with adequate technical competence and research support. To oversimplify, the preponderance of discretionary spending power rests at the Federal level, the broadest regulatory powers reside with the states, and it is widely believed that the views of the citizens are best represented through their local governments. Allee and Clavel, in their study of poultry waste pollution, concluded that effective compulsory regulation would probably require the technical capability and legal powers residing at state or regional levels [1].

It is analytically frustrating when legislatures do not specify clear and definitive objectives for public programs. Part of this situation results from sequential decision making on problems at hand combined with a general lack of capability to simultaneously review previous decisions for inconsistencies. However, part of the specification problem results from uncertainty about the probable effects of alternative decisions. The responsibility for vagueness lies partly with those individuals and institutions who should anticipate information needs and make it their business to reduce the areas of uncertainty at the time of decision. In the complex area of environmental quality, the probability is particularly great that legislative objectives will be either vague or overly narrow.

Decision Making in Bureaucratic and Legal Systems

The issues at the second level are concerned with the structure and performance of systems of constraints and incentives influencing decisions and actions by individuals, firms and groups [3]. We know relatively little about the influence of our legal framework, e.g., courts, tax systems and financial regulations, within the web of constraints and incentives surrounding our individual environmental managers. In action programs, what are the effects on management decisions of subsidy, regulation, education, or technical assistance activities?

At the program levels, there is the same universal need to make decisions based on incomplete information about feasible alternatives. How much time and resources can be allocated to reduce areas of uncertainty? Under recent Federal legislation, air and water quality standards are established on a Federal-state basis. How can these standards be met? Which instruments or combinations of regulation, financial incentives, education and technical assistance are effective, efficient and desirable for different environmental problems and situations?

If regulations and police power are to be employed, the regulations must be reasonable, equitable, effective, enforceable, widely understood, and reasonably "popular." What will various systems of regulation cost? Given the relatively high tolerance of Americans for illegal activity, what are reasonable assumptions as to levels of compliance under compulsory regulations?

McNabb has observed, regarding feedlot pollution control, that the effectiveness of extension education programs in achieving satisfactory vouuntary regulations is in doubt but that compulsory regulation, if eventually needed, will be achieved more easily and will no doubt be more effective if based on widespread understanding achieved through earlier efforts toward voluntary regulations [5, p. 36].

The economic issues surrounding the use of financial incentives for pollution control; subsidies, loans, general and specific taxes or fines are familiar to us. Who benefits? Who pays? What is efficient and what is equitable? If A pollutes B's environment, does A owe B or should B pay A to control pollution? What is an effective and/or efficient cost sharing arrangement?

There are also the issues of income distribution. Carlson has pointed out that the current establishment of air and water quality standards is a struggle between groups who will bear the burden, e.g., municipalities and industry, and the beneficiary groups, often of higher socioeconomic status, such as outdoor recreation enthusiasts [3, p. 85]. He feels, in the case of water pollution, there is evidence that redistribution of income will be regressive, benefiting higher income groups. However, in our political decision-making process, we may anticipate some adjustments between the setting of standards and their achievement.

Pollution controls may result in redistribution of incomes from upstream to downstream water users and from established resource users to subsequent resource users. Stepp has discussed the interregional income distribution issue regarding the nondegradation requirement that Federal-state waters be maintained at least at present quality levels. Had the founding fathers enforced a nondegradation erosion standard, as part of our land policy, agriculture might be limited to the thirteen original states [8, p. 6]. The point, of course, is the necessity to consider the distributional effects of environmental controls in a broad context.

The establishment of environmental controls requires compromises between the need to maintain a reasonably stable system of constraints and incentives for efficient programming of production and consumption and the need to provide sufficient flexibility to adapt the incentive system to changing technology, changing sets of tastes and preferences, or new pollutants.

The question of bureaucratic flexibility has both organizational and technical information aspects. Are generally coordinated groups of environmental agencies with narrow objectives more effective and flexible over time than superagencies with broad objectives? Federal-state programs may be more or less flexible than separate programs. How effective are advisory groups or expert consultants in achieving bureaucratic flexibility?

Decision Making by Individuals and Firms

In considering decisions by individuals and firms, it appears we have returned to more familiar ground. Perhaps, but there are still the continuing unresolved issues of benefit-cost analysis. There are the continuing ignorances surrounding the incentive effects of various taxation systems and the continuing lack of research effort on them. One of the most important questions is how governmental actions can be designed to strengthen incentives for private or voluntary decisions to manage the environment in socially desirable ways. Voluntary action in our society is considered the key to solving social problems. Even the use of police power must be predicated on voluntary compliance by the vast majority. What are the feasible and effective alternatives for achieving a widespread sensitivity about relationships between individual actions and environmental problems? What legal or program changes would reward ingenuity, development of new technology, or changed patterns of operation to reduce environmental problems?

There is the question of how individuals in various situations and various roles perceive environmental pollution situations. What do they want changed? How should it be changed? Who should change it? Who should pay for it? Because of the technical complexity of many environmental problems, large groups may be unaware, misinformed or apathetic. If so, how can this situation be reflected in decision making on environmental control?

A Strategy for Socioeconomic Research

Having considered some of the issues, what research should we undertake? It would be fine to be able to conclude that we should research the economic aspects of all these issues plus those new questions uncovered in the process. Realistically, we must content ourselves with some selected efforts.

Although there are some serious deficiencies in our theoretical concepts, the pressing need for improving the pollution control decisions involves empirical economic information. The lead priorities should be given to the empirical problems, most of which are within range of our present conceptual grasp.

Empirical case studies of pollution situations are needed. There is little information on costs and benefits for specific situations. We need to determine who is really burdened by pollution by tracing through the effects in real situations. Information is needed on the timing of pollution damages. The costs of alternative means of control are often very sensitive to the probabilities of critical pollution occurrences. It is only through development of valid information from empirical studies that the widely conflicting claims of benefits and costs can be narrowed and significant progress made toward the development of efficient means of environmental control.

The complexity and interrelated aspects of environment management support a systems approach to many of the problems involved. Both the economic effects and environmental effects should be considered. The economist and ecologist share a common systems concept in the initial stages of problem solving at least. The potential for mutually beneficial collaboration on environmental problems should be more fully explored.

Ayres and Kneese, in considering solid wastes as a materials handling problem, have demonstrated the usefulness of the systems approach for considering possible alternative actions and for highlighting critical needs for additional research [2]. For example, there has been some agitation for banning chemical fertilizers because of high nitrate incidence in food and drinking water supplies. Smith has pointed out, however, that a third of our present crop production is dependent on chemical fertilizers [7, p. 174]. A general study of nitrates using the systems approach could be useful in delineating the possible effects and costs of various fertilizer use controls.

Relatively little information is available on the reaction patterns to environmental control programs that might be anticipated from firms and groups in various representative situations. Pollution regulation may have a significant effect on the location of individual agricultural firms and the competitive positions of various producing and processing areas. Water pollution regulations, for example, might be expected to give those areas with heavy rainfall and fast moving streams a competitive advantage for firms generating large volumes of oxygen-demanding waste water.

More information is needed on the costs to the agricultural firm of alternative means of pollution control. In addition, we need to look ahead and design efficient systems of food and fiber production that will minimize pollution as a way of doing business.

While the present sources of agricultural data are not completely adequate to support environmental control decisions, there is still considerable potential for useful exploitation. Additional sources of data on the extent, location and severity of agricultural pollution will need to be developed. Some efforts have been made toward developing indicators of social welfare [10]. These efforts should be continued and expanded to more accurately gauge trends in environmental conditions.

For many important questions, it is obvious that the economic researcher will be dependent on inputs from other disciplines. Studies of environmental perception, for example, will require collaboration with other social scientists. The agricultural economist, by training and experience, is often able to work effectively in this type of situation. The particular vehicle for including other disciplines in the research approach—literature review, consultation, coordinated projects or operations research groups—depends on the nature of the problem, the resources available, and the personalities involved. However, the complexity of the problems of environmental control makes it extremely difficult to keep adequately informed on research developments in the several related disciplines.

The complexity and dynamic aspects of environmental quality problems insures that we will not lack for challenging research questions. In fact, the variety of questions provides abundant opportunity to satisfy both our intellectual curiosity and our professional obligation for relevance to pressing social issues.

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Environmental Effects of Rural Land Use

J. DELPHENDAHL

ECONOMIC growth in the United States generates various phenomena, one of which is its urbanizing effect on the entire society. This urbanization process likewise affects rural communities and the use of land resources in rural areas. National attention has been focused recently on social and economic conditions in rural America [11]. Economic growth brought also a much greater interdependence of people, regions and resources. The economic hinterland of a "fundamental community of 1968 is about 50 miles and its area is about 5,000 square miles . . . the functional economic areas of 1968 include from 100,000 to 200,000 or more people" [5, p. 1139].

The term rural land use, might be subject to different interpretations because the differentiation between urban and rural land use has recently become blurred, especially when analyzed from a sociological and economic point of view [1]. The use of land resources is frequently associated with the resource oriented industries such as agriculture, forestry, mining, and, in coastal areas, the fishing industry. Rural land use is sometimes used as a synonym for sparsely populated areas of the United States. I wish to define rural land use as the physical and economic supply of natural resources in non-urban areas, where urban is to include the urban fringe area. Rural land use, or somewhat rephrased, the use of the open country, currently receives national attention as a "by-product" of the emphasis placed on the quality of environment.

Several trends are affecting the current use of land resources in rural areas. Clawson observed in this respect that "a major but unplanned and unguided redistribution pattern of the population on land is underway in the United States" [4, p. 65]. Rising disposable income generated an increase in demand for a large number of outdoor recreation opportunities, as well as for seasonal (or second) homes. The location of these homes has an impact on the land use pattern in rural areas. The interstate highway system provides easy access to rural areas and connects these areas with metropolitan regions. It, too, is a major factor affecting the use of land resources in these areas.

I wish to divide my paper into three major parts. First, trends in rural land use will be briefly discussed, followed by a discussion of externalities and their effects on the use of the open countryside. Finally, some alter-

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Table 1. Major uses of land, United States, 1964

Land use	Acreage	Percentage of total
	million acres	percent
Cropland, including land in rotation	444	19.6
Grassland pasture and range[a]	640	28.3
Forest land[b]	732	32.3
Special uses[c]	173	7.6
Miscellaneous other land[d]	277	12.2
Total land area[e]	2,266	100.0

Source: [6, p. 2]

[a] Excludes cropland used only for pasture.

[b] Excludes 30 million acres in special uses.

[c] Urban and transportation areas, areas used for recreation and wildlife purposes, public installations and facilities, farmsteads, and farm roads.

[d] Marshes, open swamps, bare rock areas, desert, tundra, and other land generally having low value for agricultural purposes.

[e] Includes streams and canals less than $\frac{1}{8}$ mile wide; and ponds, lakes, and reservoirs less than 40 acres in area.

natives will be advanced related to the minimization of the effects of externalities.

Trends in Land Use

A superficial examination of land use changes in the United States between 1959 and 1964 might easily lead to misinterpretation. The aggregate data do not reflect regional differences in local shifts in the use of the wide open countryside [4, p. 90]. Major uses of land in the United States are given in Table 1. Twenty percent were classified as cropland but only about 15 percent were actually utilized for this purpose. Land resources in the "special use" categories account for about 8 percent [6].

A comparison of these two land use classes is made because national and state parks, wildlife refuges, and wilderness are included in this classification. It is hypothesized that parks, refuges, and wilderness areas are generally located in the open countryside. The trend of cropland use during the last several decades is well known, and therefore the discussion of land use changes is confined to the special use category. The distribution of this use category, however, varies among regions, as can be seen from Table 2.

In the Northeastern and Pacific regions, 17 percent of the total land area is used for special purposes. The percentage declines in the Lake States, Corn Belt, and Mountain areas to 12 percent. The Appalachian region follows with 9 percent. Only 6 and 5 percent of the land area of the Northern Plains and Southern Plains, respectively, are classified as "other type" of land use. The distribution of cropland, pasture, and range land, and

Table 2. Regional percentage distribution of cropland, pasture, and range, and special use categories

Regions	Cropland, pasture, and rangeland	Combined special uses[a]
Northeast	23	17
Lake States	44	12
Corn Belt	69	12
Northern Plains	92	6
Appalachian	32	9
Southeast	25	11
Delta States	32	9
Southern Plains	79	5
Mountain	65	12
Pacific	39	17
Average 48 states, excluding Hawaii and Alaska	57	11

Source: [6, p. 8].

[a] Includes cities and towns of 1,000 or more population, highway and railroad rights-of-way, airports, national and state parks, wildlife refuges, wilderness areas, national defense lands, Federal flood-control areas, farmsteads, feedlots, ditches, farm roads and lanes, swamps, bare rock, deserts, and tundra.

the combined special use category for the northeast region shows only 6 percentage points difference between these categories.

Shifts in Land Use 1959-64[1]

Between 1959 and 1964, an annual average of 3.4 million acres were shifted to special uses. The shift of land resources to rural transportation uses should be mentioned not only from the aspect of "consuming" natural resources but also as a type of externality affecting the land use pattern in rural areas. About 160,000 acres annually were shifted during the period 1959 to 1964 to rural transportation. The construction of the national network of interstate and defense highways accounts for a large portion of the shift in land resources. Estimates made suggest that about one million acres per year are shifted to special uses. An additional one million acres annually are converted to what Frey et al. called "extensive-type public acreage (recreation and wildlife and public installation and facilities)" [6, p. 29].

Effects of Externalities

In broad terms, land use in the United States is subject to two major constraints: the institutional framework and the market mechanism. The broad institutional framework always plays an important role in land resource use and management. The operation of the market mechanism that facilitates the movement of resources to the highest bidder does function to some degree within the institutional constraints of numerous public policies. These two major constraints permit both public and private activities in the management of natural resources, though Castle observed that "government intervention undoubtedly has been greater for land than for other factors when one views the entire economy" [3, p. 545].

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[1] This section draws heavily from Frey et al. [6, pp. 27–29].

One may hypothesize, however, that public policies related to the management of natural resources may become more restrictive if the recent spur in public concern about the quality of environment serves as an indication of future developments. This comment should not be construed as a value judgment about the merits of public management of natural resources.

It is the basic premise of this paper that externalities have an impact on the use of land resources in rural areas. I would like to treat the numerous public policies related to the factor and commodity market as externalities because the decision making unit is geographically removed from the area affected by the particular policy. Examples of such externalities include the vast array of policies ranging from land retirement programs to soil conservation programs, and especially the large number of area development programs. The following will illustrate this point. Many resource-based outdoor recreation areas, especially those located in the northern tier of the country, experience an influx of a large number of users during the relatively short summer outdoor recreation season. Since frequently no entrance limitation exists, except a nominal user fee, many of these areas are over-used. The majority of the users are out-of-state residents.

A 1966 study of second (seasonal) home ownership in northern New England showed that 46 percent of the owners resided in "surrounding and nearby states" [14, p. 5]. Many seasonal homes are located in rural areas where little or no land use planning exists. Many of these second homes cause "scenic pollution" because they spoil locations that have been aesthetically attractive.

I selected the term "beneficial" externality to denote policies that are generally considered to have a beneficial impact on rural land resource use. The location of a new industry in a rural area might be desirable, if it creates employment for the local labor force and therefore increases the local aggregate income. Jordan found that about "13 percent of the increase in total personal income in an eight-county Ozark area in 1960–63 can be attributed to employment" in an industry which began operation in 1960 [8, p. 4]. The results of the study of the economic impact of a state park indicate that campers spend $3.10 per person per day in the economic area of the park. It was estimated that the local income effect, using a multiplier of 1.55, generated by the state park from 1962 to 1967 amounted to

$718,798. The largest percentage of users of this outdoor recreation area are non-residents [2].

Another type of externality is characteristic of rural areas adjacent to an urban center in a radius of approximately 50 miles. They are becoming part of the living space of "rural" urban-residents who commute to their urban jobs. These are people who prefer the low density living of the rural area [12, p. 5]. Again, decisions made by the decision-making unit located outside the area under consideration will have a profound effect on land use.

Turning now to some examples of "detrimental" externalities, one can cite numerous examples of poorly designed subdivisions, uncontrolled development along country roads, or uncontrolled "cottage" development at the shores of many lakes. The pattern of regional economic growth is another type of development that affects rural land and should probably be treated as an externality. External cost savings will lead to agglomerations of industries and services that are interdependent. This process of agglomeration is one reason for the continuous growth of the metropolitan areas as well as stability or relative decline of many rural areas [10, pp. 25–26].

Alternatives to Minimize the Effects of Externalities

Externalities do exist and they exert considerable influence on the use of land resources. I would like to pose a question related to alternatives for minimizing externalities: What type of land resource use and settlement pattern do we as individuals, and as a society, prefer in the future; or, rephrased, what kind of environmental quality do we want?

Allen Kneese, in his recent monograph, suggested that "economists interested in public policy problems associated with resource development and use have usually worked within the conceptual framework of welfare economics" [9, p. 165]. As observed above, land resource use is partially determined by institutional arrangements and by the market mechanism. Thus, anticipated policy alternatives to change the effects of externalities must be politically feasible. Such an alternative was suggested by a Congressional Committee: ". . . society begins to accept common sense trade-offs" [13, p. 12]. Closely related to the concept of trade-offs is the question whether society is willing to pay for such trade-offs.

Several states enacted preferential property tax laws for the purpose of influencing land resource use in rural areas and in urban fringe areas [7]. This measure to influence land resource use is still relatively new, and its effectiveness therefore has not yet been fully appraised.

Rural zoning is another alternative frequently mentioned. Theoretically rural zoning is a possibility, but at this point in time it can be considered a novelty of land resource planning for most rural areas of the United States. Rural zoning has not yet gained broad political support and public acceptance.

Summary

To summarize, it has been shown that externalities influence the use of rural land resources. Examples of beneficial and detrimental impact of externalities have been cited. Alternatives suggested to minimize the effects of externalities include trade-offs, tax incentives, and rural land use planning.

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Externalities in Pesticide Use*

Max R. Langham and W. F. Edwards

THERE is in this country a growing desire for participatory decision making. People want their views considered in policies which may affect them, and they are encouraged by the successes of modern technology to demand policy solutions requiring little personal sacrifice. Evidence of this attitude exists in the current pesticide controversy. Many people who are opposed to the use of chlorinated hydrocarbons do not take the agriculturalist seriously when he states that the banning of these "hard" pesticides would reduce the quantity and quality of food available. These opponents do not see the problem as a choice of an adequate quantity and quality of food *or* a clean environment, but rather as one of determining how to have a clean environment without sacrifices in food production. Anyway, there is this growing pressure for our socioeconomic system to become more sensitive to all potentially relevant externalities and to include them in decision processes. Our work with pesticides was partially motivated by this pressure.[1] Specifically, we have attempted to incorporate externalities from the agricultural use of pesticides in Dade County, Florida, into a decision model to help provide a basis for more socially acceptable decisions regarding pesticide usage.

Externalities

Buchanan and Stubblebine [2, p. 372] state that an externality exists when the actions of one party (B) affect the utility (production) function of another party (A) who has no control over B's action. Their definition is exhaustive, since the end result of all economic activity is to affect and influence individual utility and/or firm production functions. They indicate that an externality is potentially relevant when it generates a desire in A to try to influence the action of B. Such will be the case whenever A's utility is not at its global optimum with respect to B's action.

Buchanan and Stubblebine's definition is myopic from the point of view of policy, since it assumes a given set of property rights and a given in-

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[1] For details of this work to date, see Edwards [3]. This work is continuing and will be reported when complete in a research monograph.

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come distribution. In policy formulation, however, rights and income distribution are potentially variable. Herein lies a measurement dilemma for the researcher. If the policy making process is to make acceptable and somewhat durable decisions, it must consider the total costs and benefits of alternative courses of action for each participant in the system without regard to established rights. But if measurement is to have an empirical basis, it must of necessity be founded in a given set of rights. Since we found no solution to this dilemma, our measurements of cost and benefits are based on the set of rights that existed at the time our data were generated. However, from this point on, we submerged the problem of property rights and were concerned with measuring the net benefits of alternative pesticide usage policies without regard to rights. Therefore, the concept of a potentially relevant externality, as defined by Buchanan and Stubblebine, constituted the framework within which we attempted to define a measure of social welfare.

Externalities cannot be meaningfully studied independently of the system which generated them. In looking at policy alternatives with regard to pesticide use, one must attempt to measure the total impact of a policy on the system. This task requires that one look at the participants (individuals or groups of individuals) in the system to see how each is affected by a particular policy. For example, we defined three participants—consumers, producers, and others. Each of these is a role oriented aggregate of individuals (that is, a given individual might play any combination of the three roles). The aggregate termed "others" included those people who were affected by the system while not engaged in a role as consumer and/or producer. The measures we chose to determine the effect of various policies on the participants were consumers' surplus, producers' surplus, and a dollar measure of external effects on the group termed "others."

One's definition of welfare for each participant of a system provides the criterion for identifying which potentially relevant externalities require explicit treatment. For instance, our measure of producers' surplus included some potentially relevant externalities as defined by Buchanan and Stubblebine. Therefore, our concern was with identifying and measuring those externalities that were *not* included in the surplus calculation.

We undertook the identification of externalities for empirical measurement in a systematic way but found it to be a rather ad hoc process. Each externality tended to be unique and could not always be objectively identified. For example, since insurance premiums are a cost of production, one could reason that the costs of an accidental poisoning of an agricultural laborer would be included in the computation of producers' surplus. However, insurance companies have no actuarial basis in their policies for accidental poisoning. As a result one could argue that the social cost of accidental poisoning is not reflected in the cost of production and to date has been so minor that it has not been of explicit concern to insurance companies in determining their rate structure.

Measuring Externalities

Considerable effort is required to get even crude measurements of externalities. First, there is little basis in economic theory for nonmarket measurement.[2] Second, because of past research inactivity in the area of non-market measurement, there has been little pressure for the collection and reporting of some very basic kinds of data. In the case of pesticide pollution, however, data availability is improving somewhat. Pesticide residue monitoring work on air, soil, water, food and feed, people, fish, wildlife, and estuarine sediments has been started.[3] But little is being done in a systematic way to measure the inputs of pesticides into the environment.[4] This lack of information on inputs will delay the determination of relationships between inputs and subsequent levels of residues as determined by the monitoring efforts. Furthermore, little is known about the relationships between damage to an environmental element and its level of pesticide residue.

In our pesticide work an attempt was made to by-pass the physical cause and effect relationships that exist between pesticides and externalities. Effort was aimed at relating a dollar measure of the social costs of externalities to the amount of a pesticide used. This effort had some rather severe limitations, however. First, only those externalities that could be observed were measured. By and large, these were acute external diseconomies which created controversy. Second, in many cases the measurement of an externality was uncomfortably subjective in that it lacked a market determination. Finally, the use of a dollar measure for social cost also required some strong assumptions concerning the marginal utility of money and income effects of price changes.

Our objective in measuring externalities was to obtain structural estimates of the function:

$$(1) \qquad C(t) = h[z_1(t), z_2(t)]$$

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[2] A recent paper by Ayers and Kneese [1] relates environmental externalities to some conventional models of production and consumption.

[3] A description of these programs is contained in [4].

[4] Two nationwide surveys to obtain regional (multistate) estimates of the agricultural use of pesticides have been coordinated by the Farm Production Economics Division of the Economic Research Service. A third is being considered and future plans call for obtaining similar estimates as part of the soil monitoring work. The effort helps fill a complete void, but it does not provide data at the local and state levels and it is limited to agriculture.

where $C(t)$ is a net dollar measure of externalities in period (t) and $z_1(t)$ and $z_2(t)$ are organic phosphates and chlorinated hydrocarbons, respectively, both in pounds of 100 percent active agent used on farms in Dade County in period (t).

The pesticide controversy mainly revolves around the two groups of pesticides defined as z_1 and z_2. The organic phosphates are highly toxic but non-persistent in the environment. Most accidental deaths and illnesses are caused by pesticides from this group. By contrast, the chlorinated hydrocarbons are relatively non-toxic and cause very few problems in the short run. But they are persistent (the half-life of DDT is over 10 years), and the possibility of their detrimental effects on the environment has created considerable social anxiety.

We found the specification and empirical estimation of equation (1) to be an interesting but frustrating experience. The conservationists view this equation as increasing at an increasing rate in z_2. Others, including most farmers, believe that the majority of costs are associated with accidents and suicides, which increase at a decreasing rate as more z_1 and z_2 are used.

After considerable effort, we were able to obtain an estimate of one point on this function for the 1966–67 crop year. We plan to use sensitivity analysis to test the stability of the model solution as the form of the function through the point is varied. Work to date indicates that pesticide usage policies are somewhat insensitive to the level of the point when one assumes a linear function through the origin.

To obtain an observation on the arguments in equation (1), we used the records of farmers and suppliers of pesticides. An average per acre usage by crops and by type of pesticide was developed and then expanded to obtain the county estimates. Sources of information on externalities included growers, insurance claims, veterinarians, biologists at the Everglades National Park, the National Audubon Society, and the Community Studies on Pesticides Program of the United States Public Health Service.

The diagnosis of pesticide poisoning of humans and pets was not precise. If pesticide poisoning was diagnosed, it was usually attributed to an organic phosphate—most often parathion. Our total cost estimate of $4,600 for the 1966–67 crop year in Dade County included those cases about which there was doubt and in this sense was biased upward for the organic phosphates.

There was very little substantive information on chronic effects of the chlorinated hydrocarbons. We have done some conjecturing (again through sensitivity analysis) about the consequences of different levels of chronic effects upon pesticide usage policies.

Incorporating Externalities into Policy Decision Models

Since Marshall first developed the concepts, economists have vacillated about the use of consumers' and producers' surplus as a measure of social welfare. Hotelling [8] and Hicks [7] revived professional interest in the surplus concept, and it now appears to have a growing acceptance as a measure of welfare for policy decisions [5, 10, 11]. Samuelson [9] remains one of its strongest critics.

The social welfare function has been useful as a theoretical construct, and revival of the surplus concept has provided one measure of welfare that is not only empirically operational but has a theoretical basis. This gain in operational significance for empirical work is probably one of the most important factors in the growing professional acceptance of the surplus concept—probably more important than the merits of the concept itself.

In their work Headley and Lewis stated society's objective "as securing that level of pesticide usage, given the technology at any point in time, that provides the maximum positive benefits over and above the negative benefits or costs associated with that level of usage" [6, p. 24]. To help attain this objective they suggested an empirical approach to the study of alternative pesticide usage policies, which was based on the concept of consumers' and producers' surplus with modification for "spillover effects" that were relevant from society's point of view but were not included in the surplus calculation.

Our approach to incorporating externalities into a decision framework for pesticide usage policies was essentially a generalization of the method suggested by Headley and Lewis. For selected pesticide usage policies, our model maximized a measure of consumers' and producers 'surplus over production alternatives available to the region. In each case the objective function explicitly recognized measurable externalities not accounted for in the consumers'-producers' surplus calculation. The maximization was restrained by flexibility constraints derived from historical cropping patterns. Finally, the policies were ranked by their maxima.[5]

Model work is under way on policies to reduce the use of chlorinated hydrocarbons. In the range from 50 to 100 percent of current per acre usage of chlorinated hydrocarbons, entomologists with whom we have consulted agree that under "average" conditions 0.3 pounds of organic phosphates will replace 1.0 pound of chlorinated hydrocarbons, both 100 percent concentrated. With this rate of substitution, results indicate that the usage of chlorinated hydrocarbons can be reduced with only minor implications for consumers, producers, and others. And the growing indication of some chronic risks associated with the use of chlorinated hydrocarbons may justify such adjustments.

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[5] The model was quadratic in the objective function and linear in the constraints. A specification of it is available from the authors.

The model has proven to be efficient in using data and is an empirically operational device for obtaining added information on the effects of externalities on the solution determined in a free market decision framework. Use also indicates that the model will be helpful in appraising policy alternatives. Our work supports the hypothesis that economists are better equipped to determine the implications of externalities than they are to measure them.

Concluding Remarks

We would like to conclude with a value judgment and a plea. The value judgment is that the responsibility for insuring that externalities are recognized in decision processes should not rest solely on externally affected parties. Society instills in each of us a great tolerance for the status quo, and if improvements in the operation of our socioeconomic system depend on individuals being "fedup," the process of improvement will be slow—perhaps dangerously so if the affected parties hold few resources and little political power. Social scientists need to be concerned with minimizing the "true" social cost of change.

Our plea is for greater support for measurement of the inputs and outputs of the environmental production function. Little is known about the quantity of potential pollutants going into our environment, and even less is known about the physical effects that are the outputs—even those that are acute and can be observed. Economists are being asked to help make decisions about environmental processes, and they know neither the quantities nor values of their inputs and outputs.

Such monitoring of inputs and outputs would not be a simple task. There would be problems of identifying the true cause of certain observed phenomena, and there would be uncertainties about "who killed Cock Robin." The social question of "so what" would also remain, and the role of value judgments would come to the fore. But if it is important that society consider the consequences to its welfare of alternative courses of action, we as economists must encourage appropriate observational processes. The existence of data will in turn encourage more economists to empirically study environmental problems.

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VIGNETTES: TOOLS OF OUR TRADE—DATA SOURCES

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A Rural Economic Indicator System

CLARK EDWARDS

THE demand for indicators describing the nonfarm economic environment of rural residents is increasing faster than the supply. A rapidly changing economic environment for farmers and other rural people is leading to accelerated economic and social adjustments for residents of farm, rural nonfarm, and urban places. Continued maldistributions of income among families, places of residence, and geographic areas are leading to increased dissatisfaction with the current economic situation. A comprehensive data base for thoroughly describing and explaining the economic environment of rural residents is nonexistent. Obstacles to setting up such a base are formidable. Collecting primary data for different project areas at different times not only limits the comparability of results among project areas but also limits the geographic range of applicability. Secondary sources of data can offer uniform coverage with respect to time and place. But the concepts reported often fail to correspond with user requirements, the reports quickly get out of date, and estimates are occasionally grossly inaccurate.

This paper deals with some activities in ERS to carry on research on rural area economic development in the widening breach of data. Given the constraint of an exceedingly limited budget, the approach has been to squeeze as much information as possible out of secondary sources. When available data didn't meet theoretical demands for empirical information, the theory was bent a little in preference to collecting new data. The approach is leading to a helpful set of descriptive indicators of regional variations in the economic environment of rural people, as well as to analytical appraisals that help to explain these variations and suggest economic development policies. An important byproduct is an improved automatic data processing environment in ERS for analysts who know economic research methods and data sources, but don't know much about computers.

Retrieval System for Secondary Data

Appraisal of the quantity and quality of secondary data available for

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economics research is sometimes reminiscent of the story about an Ozark preacher who was invited to Sunday dinner by a farmer and his wife. As the preacher was wiping his chin on his napkin after dinner and searching for just the right compliment, he heard himself saying, "That was a mighty fine dinner, what there was of it." Realizing that something was wrong, he hastily edited his remark and said, "I mean, there was plenty of it, such as it was." The latter sentiment is generally the more appropriate one in describing available secondary data sources for regional economics research, although, on occasion, one finds oneself adopting the former. Three rules used to limit the quantity and uphold the quality of data assembled were: the data source likely would be useful; the data were available at the county building block level; and the data were uniformly available for all counties. Using these rules, we estimated that there were available some 10,000 pieces of information for each of the 3,000 counties—approximately 30 million pieces of information.

Experience in copying some of these numbers onto penciled worksheets, and running up totals and means on desk calculators, soon caused us to question the word "available" as an adjective modifying "secondary data." We sought a way to automate. The Economic Development Administration (EDA) of the Department of Commerce had asked the same question about a year earlier. With their larger budget, they were working out an answer. They invited ERS to join them when they found that our data needs and user requirements were similar.

More important than the common data needs of EDA and ERS was the common approach to data assembly and extraction. Both agencies were interested in something that would become operational as soon as possible with a small core of useful data but that could be expanded as funds became available. Both agencies were more concerned with the ease of data extraction by users than with ease of data assembly by the designers of the system.

County data currently stored and operational in the system include attributes for population, agriculture, manufacturing, wholesale and retail trade, government, employment, income, and banking. The result is a useful source of benchmark information as of 1958–64. It is scanty with respect to descriptions of activity annually since. But we are working on that.

The data may be conveniently imagined as a two-dimensional array having 3,000 rows and approaching 10,000 columns. Each row represents one county; each column one attribute. Extraction of data from the system merely requires identifying rows and columns (counties and attributes) on punched cards and running them against stored data files. This merely reproduces published tables. The power of the system comes from the ease with which data can be manipulated. For examples: One can select from the 3,000 counties only those that meet certain criteria such as income per capita below $1,000; he can rank the selected counties from lowest to highest incomes; and he can generate new attributes (such as income per capita) from stored attributes (such as income and population) about as cheaply as he can simply extract data. This bypasses not only the published source but also the 10-column worksheet and the desk calculator. Users with a little computer sophistication quickly learn to move stored data into canned programs useful in economics research such as regression analysis and plot routines; or into software of their own making, say in FORTRAN.

Descriptive uses

Descriptive uses of the data retrieval system may not sound as elegant as analytic uses, but simple indicators come first and they are important. Descriptive summaries of the large volume of data into a small handful of indicators are probably the first thing brought to mind by the title of this paper. The data on file may quickly be extracted to form a *table* showing, for example, various aspects of population, income, and employment of a multi-county planning region compared with some other region during the same year or compared with itself as of an earlier period. The raw totals for the region, in conjunction with percentage distributions and various comparative ratios, make handy do-it-yourself kits for policy makers. Investigations for *associativity* suggest hypotheses for further research but, in themselves, belong on the descriptive list of products of the system. This is done by computing cross tabulations, correlations, and regression coefficients, and by preparing scatter diagrams. *Index numbers* have proven a convenient descriptive summary of large blocks of data which are used to flag geographic regions most likely to have relatively severe problems of intense poverty, underemployment, or generally poor economic health. By way of illustration, we used principal component analysis to assign weights to 10 economic and social characteristics associated with the economic health of multi-county regions.

Analytic uses

The first step in proceeding beyond the brute-force empiricism of the descriptive statistics was a multi-county delineation of the 3,000 counties into a few hundred more-or-less functional economic areas. Three candidates for this purpose undergoing testing in ERS now are about 200 regions assembled by the Office of Business Economics of the Department of Commerce, about 300 regions assembled by ERS, and about 500 regions assembled by Rand-McNally. Observations on population, income, and employment for several hundred regions are used to test hypotheses about economic development. The economic theory proving most useful in our static models is that of Keynes and the macro-economists. Micro-economic formulations have not been as fruitful in suggesting hypotheses with respect to multi-county or multi-state economic activity. Either theory has needed extensive supplementation with respect to demography and location. Analyses over time have veered away from growth models depending on capital accumulation (for which we have little regional data) towards labor force expansion through changes in migration, natural increase of population, or willingness of the population to participate in the work force. To fill these theoretical boxes with data from our information system, we have incorporated matrix algebra, simultaneous systems of equations, input/output, linear programming, and simulation algorithms.

Summary

A rural indicator system is under construction in ERS. An input to the system is a data bank containing county population, income, employment, and other characteristics. A unique feature of the bank is that all data are converted to a standard format which, while making it harder to build data files, simplifies the procedure for data extraction and manipulation by users. The data are being summarized into descriptive indicators of regional variations in economic activity, for example, with index numbers. And the data are being combined with structural information, such as that relating to resource productivities and elasticities of demand, to build analytic models for appraisals of prospects for growth in rural areas. Results so far suggest that a good deal of useful description and analysis can be derived from secondary data sources.

Farm Panels as a Source of Farm Management Data: The Cornell Producer Panel

GEORGE J. CONNEMAN

ALTHOUGH panels have been used in consumer research for a number of years, the use of a panel of producers or farmers as a source of farm management data or for studying changes on farms over time is a more recent development. Basically, a producer or farm panel is a group of farmers questioned and revisited over a period of time to obtain various types of information.

Studies using the panel technique were initiated at the University of Minnesota [9] and Cornell University [2] in 1959. These panels were directed to analyzing changes over time in the quantity and characteristics of resources associated with changes in milk production on dairy farms and to projecting future changes. At Ohio State, panels have been used as a technique for obtaining input-output data [8].

The purpose of this paper is to describe and evaluate the Cornell Producer Panel. The sampling technique and cost of obtaining data are discussed. The usefulness of such a panel in determining rates of change in size and technology and in assessing farmer behavior is considered. The advantages of producer panels over other techniques and the future use of a panel of this type are indicated.

The Sample of Farms

One of the distinguishing features of the Cornell Producer Panel is that producing units within designated areas or segments rather than "farmers" were the sampling units. The farms included in the Cornell Producer Panel represent a statistical sample from a universe of farms in the New York milkshed area.[1] The random sample is of *farm segments* or groups of farms rather than individual farms.[2] The panel was based on a 2.5 percent

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[1] Cornell University Agricultural Experiment Station State Project 502, *An Economic Analysis of Long-Run Changes in Milk Production in the New York Milkshed,* financed by a research grant from the New York-New Jersey Market Administrator.

[2] The probability sample of milk producers selected for study was based on the geographic, systematic sample of small area segments drawn from the producing area, after stratification by region. Each segment was drawn to contain either five or ten dairy farmers whose milk was priced by the New York-New Jersey Milk Order. Although sampling was on the basis of producers delivering to New York-New Jersey plants, dairy farmers delivering to other markets and farms not producing milk were identified within each of the segments chosen. Sampling was at a rate

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random sample of small area segments. All dairy farms and all other nondairy farms that fell within the segment area were enumerated. Area segments made it possible for farms that were not producing milk at the outset to enter the sample at a later date. Segments also allowed the measurement of the effects of farm consolidation. All potential "producing units" in each segment were interviewed regularly.

Data Obtained

Data on milk production and farm characteristics during the period June 1960 to June 1968 were gathered from a sample 1,700 milk producers in the New York milkshed area[3] included in the producer panel. Several universities in the Northeast cooperated in the project. The farm data were gathered by a combination of personal interviews and mail surveys. The initial visit to each farmer was made in 1960. Repeat personal interviews were conducted during the summers of 1961, 1962, 1963, 1964, and 1967. A mail questionnaire in June 1965, 1966, and 1968 provided some data. (A mail questionnaire was also used between personal visits in January 1961, 1962, 1963, and 1964.)

Detailed information on farm business organization and resources and the personal characteristics of the farmer and his family was obtained during the first visit. This included detailed information on current cropping systems and livestock enterprises, buildings, machinery and equipment, and labor supply. Data on the farm operator included family composition, age, off-farm jobs of the operator and his family, and tenure. Data on changes in resources and production were obtained in subsequent personal visits. The mail questionnaire in 1965, 1966, and 1968 provided current data on cow and heifer numbers as well as any change in the method of delivering milk.

Information was obtained from this panel not only on continuous producers but also on farms that went out of production (exit) and those that began production (entry). Thus, the full spectrum of changes in milk output was included. Exit producers were interviewed as to the reasons for discontinuing farming, the present use of land and building resources, and their present occupation.

On personal interviews, the rate of non-cooperation averaged approximately 2 percent each year, but the people who refused to supply infor-

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of 2.5 percent of the New York-New Jersey Order producers. This sampling procedure is the equivalent of dividing the entire milkshed into area segments of approximately five or ten producing units, and selecting the appropriate number of sample segments by a random sampling process that ensured geographic distribution of the segments. The mechanics of drawing the sample and of evaluation of the sample from a statistical standpoint are given in [5, pp. 7–14].

[3] The New York milkshed covers parts of six states: New York, New Jersey, Pennsylvania, Maryland, Delaware, and Vermont.

mation were not the same each year. Thus, over the entire period only 14 farmers of the original 1,700 were never interviewed. This high rate of cooperation was attributed to several factors:

1. Well-trained enumerators.
2. A relatively short well-designed interview schedule, relevant to the purposes of the study as explained to the producer. Interview time on each visit was 45 to 60 minutes and dealt with resources and change in resources and not total inputs.
3. The return to producers of preliminary findings of the study between visits.
4. The between visits contacts provided by the mail questionnaire.
5. Continuity of the supervision of the project.

The mail questionnaire averaged better than 85 percent return (with an additional 5 percent return by field follow-up). Usually 50 percent of the first mailing was returned, about 25 percent after the second mailing, and the remainder following a third mailing. The mail questionnaire consisted of a 3 × 5 card with 3 questions to be returned in an enclosed self-addressed envelope. A "gimmick" was used on several occasions to encourage the return of questionnaires. The gimmicks were generally educational yet personal in nature and included: a black and white snapshot of the producer's barn, a topographic map of the area in which the farm was located, a physical map of the area, and a rain gauge. The relatively high returns by mail are attributed to the contacts by personal interviews, as well as the interest developed by the gimmicks. The gimmicks were mailed with the questionnaire rather than being offered in return for a completed questionnaire.

Cost of Obtaining Data

The data gathered by personal interview cost approximately $10.00 per dairy farm interview. This includes all direct costs except professorial direction and planning. It includes salaries and travel expenses of field enumerators but *does not* include the salary or expenses of the project leader or secretarial and office help used in tabulating records after field work was complete, although field enumerators usually were used for this purpose. The quoted cost does not include the expense of drawing the original sample.

The data obtained by mail questionnaire cost about $0.75 to $1.25 per returned questionnaire, depending on cost of the "gimmick" included. Only a limited amount of data on cow and heifer numbers and change in method of delivering milk were obtained by the mail questionnaire.

Advantages of the Panel Technique

The Cornell Producer Panel has definite advantages over other methods of studying and analyzing certain types of changes. Since the producer panel uses the individual farm as the basic unit of inquiry, the panel provides a record of the actual changes in milk output (and other factors) on individual farms over a period of time, as well as a means for relating changes in aggregate supplies to individual farms changes. Thus, panel data presents opportunities not possible with time series data, i.e., the estimation of changes in aggregate statistics. Furthermore, the type of data obtained over time from a panel of dairy farms documents the adjustments that occur on dairy farms and describes the mechanics of change in milk output. Panel data are useful in identifying and analyzing changes in resource use associated with change in milk production.

In addition to these description data that are generated over time, a producer panel also provides detailed data of the type required for a research technique such as the Markov process. The initial Markov matrix and transition probabilities developed from the producer panel data provide a wealth of information about the dynamics of changes in herd size and permit the examination of the crosscurrents of change taking place *within the overall trend.* The Markov process also can be used to generate distributions of factors other than size of herd. Crop acres, age of operator, or a combination of these factors with size of herd illustrate possible distributions. Production per cow and number of cows and the distribution of herd size could also be used to estimate total milk production. Producer panel data are currently being summarized on the changing land use pattern on dairy farms.

Panel data provide useful insights into dynamic aspects of dairy production, including importance of entry and exit of farms [7]. For example, in New York State, nearly 22 percent of the farms in production in 1960 had exited by 1965 and nearly 5 percent of the farms in dairy production in 1965 had entered during the previous five-year period. The data on exit and entry of dairy farms in the New York milkshed area and New York State illustrate the need for an explicit method for this type of data in designing a sample and in collecting and analyzing the data. A producer panel is one such technique of data collection. Estimates of supply response can be improved with accurate data as to the numbers of farms that enter the industry, leave the industry, and continue in the industry. The producer panel is a good method for obtaining these data for a fixed geographic area.

A panel of the Cornell type also is useful in conjunction with specific or general surveys, and farm account group data. The panel data, which is a representative sample, allow a perspective to be gained on the representativeness of the surveys and account data.

Data from the panel have been used as an input in a large-scale project designed to examine the agriculture in New York State toward the year

1985. Markov process analysis formed the basis for projecting trends in cow numbers and milk production.

Producer panel data also has been useful in testing various hypothesis concerning supply response. The magnitude of exit and entry and the relationship to farm size and resources and differing by size group and resource group have important implications for the changing resource base of representative farm studies. These data provided an opportunity to test the representative farm concept and the assumptions which underlie it [1]. The study suggested several possible ways in which classification for representative farms may be improved.

Future Plans

The future of the Cornell Producer Panel is currently under study. If financing can be obtained, current plans are to revisit the farms during the summer of 1970. Also, the Northeast Dairy Adjustment Committee has discussed the possibility of expanding the present panel to include the remainder of the Northeast region.

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Farm Panels as a Source of Farm Management Data: The Ohio Plan*

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FARM management surveys, cost route studies, and farm business analysis summaries were employed successfully as farm management data collection techniques prior to the decade of the 30's. Considerable debate about the merits of each of these techniques ensued. Costs, accuracy, representativeness, applicability, and information detail capability continue to be deliberated by farm management researchers.

Most farm management students are knowledgeable about the evolution and limitations of farm management surveys, cost accounts, and farm account record analysis and summary projects. M. K. Bennett and the Taylors have made extensive reviews of the development and evolution of these techniques [1, 2]. Farm operators and change agents working with farmers have benefited from much useful managerial information resulting from the employment of these information collection methods. Availability of information obtained from studies in which these data collection techniques were used has enabled farm operators, owners, and managers to make better decisions than might have been possible otherwise.

Ohio farm management personnel were involved in the developments and have used most of the data collection techniques cited. Development of farm firm structural changes, increased capacity to handle data, and more sophisticated programming and planning techniques, coupled with increased data collection costs have again caused us to seek data collection improvements. Need for specific operational and organizational managerial production transformation information has increased. Data users demand and need "up-to-date" and "accurate" information in order to use existing and developing data programming and processing capabilities in an efficient and useful manner. The continued quest for improvement and the increasing costs associated with data procurement have resulted in the development of the "farm panel" technique.

A farm panel is a purposefully selected group of operating farmers, who, with professional assistance, provide detailed business and operating information for a two- or three-year period. The panel is originated after a research need is carefully identified and sample criteria are established

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dependent on the research requirements. Typically, a purposeful sample of farm firm operators and/or owners has been used; however, most direct response sampling techniques can be used to identify the respondents.

Rigid sample criteria have been established and the respondents have been rotated off the panel and/or the panel discontinued as deemed desirable for the established research needs. For the Ohio projects it was originally proposed that carefully selected rotating participant panels be established and continued for each of the major farm types. Other panels could be established to procure data for specialty crops and minor enterprises as needs were identified. These panels would be continued for two years and then discontinued. For example, dairy, hog, cash grain, beef, and selected combination enterprise farm panels could be operated on a continuing rotation with vegetable, fruits, sugar beet, and other important but secondary enterprise types operated periodically. Within each panel the farmer respondents would be selected and rotated in accord with the defined need. This rotation of panel participants could be based on such criteria as facilities used, livestock numbers, cultural practices, geographic location, etc.

Area extension farm management agents serve as the local cooperator contact in Ohio. This important local contact relationship has been beneficial, resulting in realization of accurate and meaningful information flows. The area farm management agents have established a continuing relationship with farm clients and county agents and are amenable to a centralized research control. Both research and extension budgets contribute to support the project. A significant ancillary contribution has resulted in the wedding of extension with research interests and programs. The personal involvement of the area farm management agents has proved to be an important component in using the farm panel technique. Cooperation of farmers is much improved when the agent makes the direct contact and can provide useful information feedback to the respondent. Phone, mail, and personal contact with and through the research coordinator, area agents, and farm respondents has been developed in a meaningful manner. All the personnel involved appreciate their responsibilities and benefits; thus, cooperation has been excellent.

Empirical deviations have often plagued researchers in the assemblage of input-output transformation studies of farm firm activity. Some deviation results from variations in conditions beyond operational research data procurement control. Other variations may result from the desire to use particular production practices, equipment complements, and production procedures by a farm operator. Often the production methods used by the farm operator become routine; consequently, he may not realize the need to provide the detail needed by the investigators. Data gathering agents in frequent contact with respondents have a much higher probability of identifying causes and evaulating information deviations.

Samples have been purposefully selected within the established criteria. Lack of representation for descriptive purposes may be a shortcoming for some research needs, but no more so than with many other techniques. Voluntary samples and the non-response bias found in many farm surveys have caused data collected to lack the representative quality often sought. With the purposeful sample control, possible with the farm panel, the population can be accurately identified. Sample size as used in Ohio has been varied with the range in the control criteria. For example, in a two-year cost of cattle feeding study we used 91 records for the first and 77 records for second year of study. Sixty-seven records were used the first year and 81 for the second for a study of swine production. This study was designed to procure input-output transformation rates for the breeding herd to weaning and the feeding of market hogs. In a crop production cost study we used 33 and 47 records for each of the two years.

Our panel respondents provide a complete and detailed farm business financial record for the firm. We have used the Commercial Ohio Farm Account Book as the basis for the farm business financial record. Additional special data collection instruments are used for the collection of detailed physical and other operational information sought. The activity or enterprise can then be investigated during the course of the panel's existence with a more complete knowledge of the operator's and the firm's activities. The use of farm panels has provided useful data for many research needs that were not available in data collection techniques used earlier.

Farm data panels have been used in Ohio for hog, beef, cash crop, dairy, and some specialty farm production activities. Results have been good. Cost of acquiring input-output information has been less than for other methods we have tried capable of yielding accurate information. The use of carefully selected purposeful farm panels, coupled with a responsible personal proximal to respondent contacts and a centralized research control has yielded a very desirable result.

Schedules of input-output transformation have been generated in a most satisfactory manner. We believe the technique is a definite improvement over the survey or modified cost route survey method and plan to continue using farm panels for the procurement of farm production coefficient information.

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Response Problems in Probability Sampling

JOHN W. KIRKBRIDE

"ONE of the curious features of statistics is that the more closely data represent the actual facts and the wider the appreciation of their accuracy, the more subject they become to criticism." This was an observation made in 1904 by Mr. John Hyde chief of the Statistics Division, USDA. He attributed this phenomenon to the fact that as their general accuracy is more widely recognized, data necessarily exercise a greater influence upon the markets, thus inevitably favoring or antagonizing those engaged in the game of agricultural production. Adverse comments of the losers are generally by far the most vociferous.

The present day economic structure feeds on a wide array of statistical facts. However, the statistical appetite of the economic society continues to demand broader coverage, greater detail, and increased accuracy. The use of objective methods of sampling will assist in bringing about improvement in accuracy. Probability sampling is such an objective method.

Probability sampling is an apparently simple term. Yet this appearance is deceiving and often leads to simplistic treatments that generalize too broadly, start from a doctrinaire position predetermining answers to problems, or concentrate on a single aspect of a survey to the exclusion of others. Probability sampling is a term of rich conceptual and empirical meaning; conceptually, it can designate statistical truth. It is not easy to conduct successfully in our pluralistic society.

Requirements

Probability sampling requires of each element in the population a known non-zero probability of being sampled; therefore, the implementation of probability sampling requires the establishment of a sampling frame. Frames may be characterized as accurate or inaccurate. In an accurate frame, all units resulting from the adopted definition of the population are included once and only once. Frames not meeting this criterion are called inaccurate. A common weakness in such frames is incompleteness. Seldom is the accurate sampling frame readily available. However, good sampling frames, properly constructed even though incomplete, have much potential for improved accuracy.

Constructing sampling frames to measure agricultural needs is particularly difficult—the number of establishments is large—change occurs daily —an increasing number of establishments are complex business enterprises

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interwoven with agricultural and non-agricultural activities. There is an increasing problem in defining the operator for these complex enterprises.

Coverage

Corollary with the requirement that each element in the population be provided a non-zero probability of being sampled is the need for each element selected in the sample to be represented in the survey results. Satisfaction of this requirement presents a challenge to the success of probability sampling. How to obtain complete response? Lacking that, how to provide accurate information for elements missing due to the absence of an informed person or outright refusal? Use aerial photography? Useful to the extent it is available and for selective items. Make ground observations? Limited to what one can see. Talk to relatives, neighbors or anyone handy and willing to talk? How reliable are responses to items such as intentions, living and production expenses, and income, that can be accurately supplied only by the operator? Lacking his presence or cooperation, how is this element represented in the sample? By substituting data from an establishment that responded and has a similar operation—or the one listed just ahead or behind the missing report—an average of a selected group of responses—the average of all responses—or is information manufactured based on all the threads of evidence that can be pieced together about the establishment? This is done, utilizing means that seem best for a particular situation. Can one have confidence in results derived from such procedure, especially results that include data imputation for a significant number of large operations?

One can speculate about the missing respondent problem in the future. Numbers of farm establishments are declining, though the current three million still provide a large population to sample. The trend toward commercialization and larger operating units gives substance to the idea that 300,000 farms will soon be marketing two-thirds of all farm products marketed. Shrinking the population to be sampled to about one-half million may mean a whole new ball game in data collection. Can information be imputed for one large operation? Will the trend to bigness lead to mandatory reporting—an unpopular term in the present climate of invasion of privacy?

Size Versus Response

Is there a relation between size of operation and willingness to cooperate? We think it is inverse, but the reluctance of large operations to cooperate may reflect a press for time, the multitude of inquiries received, and that they get involved in numerous surveys. Survey design and collection procedures need to recognize the many demands on this person but, if selected, there is no alternative but to attempt to get the facts about his operation. Otherwise, the survey results may not be accurate. What is the magnitude of missing reports in a probability sample survey? A conclusive answer may not be possible as the magnitude will vary with the survey and the population. However, a series of recent livestock surveys demonstrated a rate of about two percent in the smallest size group progressing through a rather uniform rate of increase to a level of 15 percent in the largest size group. Rate for the surveys averaged about six percent. These rates are disturbing, particularly rates in larger size groups that exert significant control over the total population. Data indicate the rate is increasing in larger size groups more rapidly than in smaller groups. Surveys that relate to crop acreage tend to have lower rates as the land use can often be observed by an enumerator. As an example, for the 1969 June Enumerative Survey, the refusal rate was 1.5 percent and the observed rate was 2.0 percent. It should be noted that the major thrust of the June Enumerative Survey is for crop acreage and land utilization. These items lend themselves to visual observation and measurement on aerial photographs.

Who Is the Respondent?

In mail surveys, questionnaires returned voluntarily are usually completed by the operator. Data for their farms should be accurate. Instructions for probability surveys stress that information should be obtained from the farm operator or other well informed person. Repeated contacts are required to meet this condition, but surveys with limited data collection periods may encounter operations where no one connected with that operation can be located. The enumerator must get it by the best means available. How much information is obtained through such means? For the 1969 June Enumerative Survey, information was obtained from the operator for 65 percent of the farm operations in the sample, nearly 11 percent from the operator's wife and about 7 percent from another relative associated with the operation. This frequently was a son or daughter. Hired workers employed on the farm made up two percent of the respondents. Thus, it can be assumed that information for 85 percent of the operations was obtained from persons well informed about the farm. Nearly 10 percent was reported by neighbors and about 2.5 percent by other persons in the area. Refusals and observed reports accounted for 3.5 percent. Again, the June Enumerative Survey may not be typical in view of the nature of much of the information to be obtained. Also, these percentages do not indicate the portion of the agricultural data represented by the 85 percent. But the results are indicative of the difficulty in obtaining response directly from the farm operator.

The Cost Alternatives

It is expensive to collect data by personal interview. A cost of $15 per personal interview is not unusual. Cost considerations focus attention on other methods of collecting data. Mail is a time honored method and is inexpensive. It is used extensively. Telephone interviewing is relatively inexpensive and is on the increase. What is the consistency of information provided by mail versus telephone versus personal contact? Evidence is accumulating in this respect as the combined tri-method of conducting probability sampling is expanded. There is reason to believe there may be a difference in level of reporting, at least for certain kinds of data. A recent livestock survey had about the same number of reports received by mail and by telephone. The mail averaged more livestock units per report than the telephone. The survey contained six size strata. Each stratum showed a consistently larger number of units reported by mail. Another survey relating to crop information showed no significant difference by the method of collection. Does this indicate that bias may be introduced for some kinds of information by the method used to collect the data?

The telephone also has the potential to increase the refusal rate. It is easy to terminate a telephone conversation by just hanging up the phone. This generally precludes further follow-up on a personal basis, and may trigger a position of permanent refusal on the part of the respondent. One cannot overlook the rather glowing reports of the success encountered by some that have used the telephone interviewing technique. We are optimistic that our endeavors will be equally as successful.

VIGNETTES: DEMONSTRATIONS

CHAIRMAN: MILTON L. MANUEL, KANSAS STATE UNIVERSITY

Trials, Errors, and Successes in Agribusiness Education at Purdue

JAMES C. SNYDER

THIS paper summarizes briefly our experience at Purdue in developing an agribusiness management curriculum. Specific educational goals of the program are given in subsequent discussion. Four overall goals represent our current thinking in undergraduate program development. The undergraduate curriculum should include:

1. A broad and liberal education in the social and natural sciences.
2. Adequate professional emphasis to enhance student placement and performance with business firms upon graduation.
3. Adequate academic emphasis to provide the foundation for graduate work in business management and/or economics.
4. Adequate agribusiness emphasis to provide the student with special insights into the unique problems of agribusiness without becoming involved with the specific trade practices and problems of any one agribusiness industry or job activity.

Overall graduate curriculum goals have emphasized excellence in academic performance, with sufficient applied problem analysis to acclimate the student to the workings of the business world. In this manner, both academic and industrial placement needs are met.

Undergraduate Curriculum Profile

The undergraduate curriculum emphasizes basic management principles and techniques useful in the managerial decision-making process. These are taught within the context of a broad academic base that provides a foundation for future growth and specialization. Based on a core course offering covering the major business functions, the curriculum encompasses a wide range of allied and underlying disciplines, of which economics is most heavily emphasized. Major features and structure of the program can be highlighted as follows:

(1) Training in agricultural economics and economic theory constitutes a fundamental foundation in the curriculum (22 semester hours).

(2) The agribusiness management core consists of four broad-gauge

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management courses that are taught within the department. Six hours of managerial accounting are prerequisite to these courses. The core courses —financial management, marketing management, production management, and policy formulation—permit rigorous exposure to the basic problems, principles, and approaches in each of these major areas of business activity. Specialized subjects such as advertising management, food retailing, and transportation are religiously avoided.

(3) A minimum of 28 hours in physics chemistry, biology, and related "hard core" science is required. This type of training provides some degree of science superiority over traditionally trained business students.

(4) To ensure a broad exposure to the social sciences, all business students are required to elect from 6 to 15 hours in *each* of the following areas: psychology; sociology; humanities; social, economic, and legal foundations; communications; and mathematics and statistics.

(5) Modest use is made of modern decision techniques. All students gain familiarity with linear programming, exponential smoothing, queuing theory, network analysis, and systems simulation. About one-half of the students gain some working knowledge of these techniques.

(6) Significant progress has been made in the generation of original agribusiness teaching materials, including case problems and computer oriented management planning and control systems.

It should be emphasized that the core courses are taught by members of our department. Extensive use is made of other departments, including those of the business school, for elective course offerings, but the student has his primary academic and counseling home within the department. In our opinion, it is unreasonable to assume that staff members not trained in business can plan and execute a business management curriculum wisely.

(7) The agribusiness curriculum is sufficiently independent to be identifiable as well-planned, high quality management training program, distinct from traditional agricultural economics. We attempt to hold for well-defined standards of performance in the core areas of business management. These standards have been fairly clearly established by the leading business schools, national studies, and general consensus within the business community. The agricultural label is sufficiently muddy without reinforcing past prejudices through uneven, unbalanced, and inadequate exposure to areas of study most businessmen consider important.

Undergraduate Curriculum Problems and Progress

The undergraduate program has been well received by students and business. Two major issues in the program involving both problems and progress relate to (1) the status of business management per se within an agricultural economics department and (2) the role of the underlying disciplines.

Recall that we have emphasized the idea of a well-coordinated core of professionally oriented business courses endogenous to the department. It has proven to be a good one. Departmental control can assure quality instruction and proper course content. In this manner we have provided a somewhat unique synthesis of traditional business management and modern decision theory within an agribusiness environment.

The essential problem in this approach has been one of staff continuity and training. Hiring and promoting staff people with an academic background different from traditional agricultural economics presents an administrative challenge. Moreover, the emphasis and content of truly management oriented courses is liable to be under question by those who view the world strictly in terms of economics

A second major area of both progress and problems is that of the role of the underlying disciplines. We are well pleased with the liberalizing influence that study of these related disciplines has brought to our students. We are much less pleased with the extent to which these disciplines have actually been integrated into the management decision-making process. Lack of integration and effective use of the behavioral sciences, economics, and mathematics is partially a function of the type of instruction and course content in the underlying disciplines as well as in the management courses. We have room for growth in both areas.

Graduate Curriculum Profile

Graduate training in agribusiness management is highly diverse. All students must demonstrate proficiency in agricultural economics and economic theory. Students choosing the business management specialty elect 9 semester hours of management courses at the M.S. level and 15 semester hours of management courses at the Ph.D. level. In actual practice, management training may be emphasized more heavily than these requirements indicate.

Considerable diversity of opinion exists among our faculty as to a proper curriculum balance between professional vs. academic emphasis. Most of our faculty do not favor a major emphasis on the professionally oriented business management courses, such as marketing or financial or production management. The priority of interest is in the development of research scientists and teachers and/or in line oriented personnel with research capability. From this standpoint, management science courses are more compatible with the educational philosophy of the department than the applied professional courses. Fortunately a wide range of both types of courses is available within the graduate business school. Additional management science courses are offered within the department.

The dissertation research for agribusiness students focuses primarily on management science projects conducted in close cooperation with agribusness firms. These cooperative projects require original contributions in management science that have current or potential application in decision making. Thus, the student is expected to demonstrate proficiency in both theoretical development and applied problem solution.

In addition to a successful wedding of theory and practice, this approach provides the student with excellent insights into actual business operation and management practice. Moreover, the nature of the research necessitates establishment of rapport with both line and staff people in middle and top management positions. In our opinion, these experiences are of major benefit to the student, whether he is interested in academic or business research or in line management.

In summary, then, our business oriented graduate student will be (1) well grounded in economic theory and its applications to agriculture, (2) capable of developing and using modern management science techniques, and (3) well prepared for either staff research or line management positions. Judged on the basis of industry financial support, student interest, and academic and industrial placement of graduates, there have been few problems to hinder our progress.

The Illinois Agricultural Industries Forum*

HAROLD G. HALCROW

THE Illinois Agricultural Industries Forum is a two-day seminar program for leaders and decision makers in the agricultural industries field. The program has been held each year for the last 11 years in late January or early February, except for one year. The primary theme of the Forum has been related to change in the agricultural industries or anticipated change, implications, and alternatives for development and public policy. Its first theme, in 1959, "Tomorrow's Farm Challenge to Food and Agricultural Service Industries," was an idea of interest throughout the succeeding decade. Themes generally have related to agricultural development potentials, to financing, new products, new systems, anticipated changes ahead. The Forum's theme this year was "Issues and Choices in a Changing Agriculture," as viewed by speakers, panel members, and other participants.

Purpose

The general purpose of the Forum is chiefly educational—to serve the 500 to 800 people who generally attend and to bring the results of the papers and discussions to a wider audience through publication and subsequent meetings. The program is designed to permit people to participate in open discussions about common problems. More specifically, the purposes are (1) to study, evaluate, and report changes in the techniques and management of resource use; (2) to consider problems and organization, operation, and changes in resource requirements of modern agricultural industries; (3) to anticipate direction and magnitude of change in size, organization, and operation of production units; (4) to understand changes in market organization techniques and to review changes in organizations and structure required to get products from the farm to the consumer; (5) to review changes in the agricultural input industries and alternatives for improvement in supplying resources to agriculture; and (6) to review alternatives in public policy as they pertain to changes or improvements in the agriculture industry and farm sector.

Program Planning and Development

During the first several years of the Forum, planning meetings were

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[*] The assistance of E. E. Broadbent and H D. Guither was instrumental in the development of this paper. Broadbent served as the general chairman of the Forum during the first four years and carried the major responsibility for organization and development. Guither is serving as general chairman in 1969 and 1970.

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held in Chicago and St. Louis with representatives of industry and members of the department staff in agricultural economics. These were invitational meetings, sometimes with a luncheon or dinner sponsored by a bank, association of commerce, or some other agricultural industry interest. At these meetings suggestions were made regarding current major problems that needed discussion. Usually the general theme was suggested and approved, and committees were assigned to discuss further the program for each special interest area. Suggestions were brought back to the general college Forum planning committee and were refined and organized into the basic Forum program.

In recent years chairmen of the general and special sessions, appointed by the head of the department, have met as a committee and then consulted informally with industry leaders, either individually or in small group sessions and discussed themes, topics, and speakers for the various sections of the Forum. Other staff members have also been asked to submit names of potential speakers. Major strength of the Forum has been this personal involvement in program planning and in selection of knowledgeable speakers and panel leaders.

Program Format and Topics

The basic structure of the Forum is a combination of general sessions at the beginning and at the close of the two-day program and special group sessions representing commodities or special interest areas. Speakers and panel members are drawn from the staffs of the University of Illinois and other universities, state and federal governments, and industry.

The general sessions are planned to discuss current problems that hold a common interest for all segments of our economy. This year, for example, the general sessions discussed "Today's Problems and Alternatives for Agriculture as Viewed by an Economist, a Newspaper Editor, a Farmer." Another session considered "A Changing Agriculture and the Responsibilities and Needs of the College of Agriculture," and a luncheon speaker discussed "Issues and Choices for the Future of the Agricultural Industry." Other broad topics in earlier forums were "The Impact of the St. Lawrence Seaway on World Markets" and "Managerial Strategies for the '70's," including "Strategies for Rural Development," "Financial Strategies for Commercial Agriculture," and "Organizational and Operational Strategies." Topics sometimes range beyond the national situation; in 1967 the major theme was "Implications of the World Food Situation for United States Agriculture." The 1966 theme was "Financing Market Development" with related topics on "Expanding Role of Credit in Agricultural Industries," "The University's Role in Agricultural Finance," and "Capital Requirements in Modern Agricultural Business." A complete list of Forum themes over the years is appended.

The special group sessions are intended to bring more micro-economic discussions before smaller groups representing commodities or special interest areas, such as grain, livestock, dairy, poultry, farm supplies, food processing, building and equipment, feed and fertilizer, area resource development, and agricultural finance and credit.

Financing the Forum

The Forum is financed by registration fees and small supplemental appropriations from university funds and by use of university facilities for producing programs, papers, and publications. Those not on the program pay a registration fee, $6.00 in recent years. This does not include housing and meals. Convenient and adequate facilities are assured by advance registration. Block reservations are usually made at local motels and hotels.

A heavy commitment of staff and university facilities is required for a successful forum. The program can be made effective only if staff members are willing to invest time in organizing, developing, and promoting different phases of the program. People in agricultural industries and in the business community also need to contribute considerable time and enthusiasm if a successful program is to develop.

Opinion Survey

Participants at the 1969 Forum were surveyed to obtain their opinion about program and other matters. Two hundred and twenty-four participants responded: 59 percent were listed as managers, employees, or board members of business firms; 16 percent were farmers who were board members or officers of business firms or cooperatives; and the remaining 25 percent were trade association representatives, employees of government agencies, university staff members, members of the press, or unidentified. The majority of those attending had attended previous forums; only 38 percent of the respondents were attending for the first time, while 94 percent said they would like to attend future forums. Special sessions in grain marketing, finance, livestock marketing, and dairy marketing rated a high percentage of excellent and good responses. The general conclusion from the survey is that the program topics must be current and relevant to the interests of the participants and present ideas that are useful to those working in agricultural business and industry.

The 12th Agricultural Industries Forum is scheduled for February 3–4, 1970. The general theme will center around policy choices for agriculture and the implications for agricultural industry. The central idea is to view policy choices in relation to the growth and development alternatives in agriculture during the 1970's, the changes in structure that are likely to occur, and the alternative ways of organizing for efficient growth and development. Topics will relate to the money problems of agriculture, to anticipated developments in the managerial revolution, and to new ways of doing business in the agricultural industry field, including the increasing use of contracts, new roles for bargaining, and the like. We hope that many of you will be interested, and we invite you all to attend.

Conclusions

The success of such a forum program requires a number of things: (1) There must be a firm commitment by a significant number of the department staff; (2) staff members committed to work on the forum should have very good contacts with industry and must be respected for their leadership and competence in the area; (3) contacts with industry people should not be sporadic, and discussions concerning program and development of the forum should be undertaken in some depth; (4) thorough discussion of theme and program is needed prior to organization of the forum, with full consideration given to views of industry representatives; and (5) the concept of industry leaders working with university and government personnel is crucial in developing a spirit of cooperation and participation. American industry contributes to many educational and research activities. Participation in our forum provides an opportunity for the agricultural industries to make their contributions.

Themes of Agricultural Industries Forums, 1959–1970

1959	Tomorrow's Farm Challenge to Food and Agricultural Service Industries
1960	Planning for Dynamic Growth
1961	Meeting Changes in Agriculture and Industry
1962	Meeting Changes in Agriculture and Industry
1963	Projecting American Agriculture
1964	Building Markets at Home and Abroad
1965	The Market for Agricultural Industries
1966	Financing Market Development
1967	Implications of the World Food Situation for United States Agriculture
1968	Managerial Strategies for the '70's
1969	Issues and Choices in a Changing Agriculture
1970	Policy Choices and the Impact on Agricultural Industry

Extension Transportation Programs to Improve Marketing Efficiency

WESLEY R. KRIEBEL

MANY marketing firms face sharply higher costs of operation, due in part to the service costs and other problems of owning a truck fleet. Relief from these headaches is a strong selling point of the truck-leasing companies. Large-truck maintenance now surpasses 3.8 billion dollars annually, and delivery expenses in the urban environment are approaching $9 per hour. Profit-seeking managers are looking for ways to control transport as they control other production expenses.

Because transportation is not their primary business, many agribusinesses have limited management knowledge and capability in this field. Transportation expenses cannot be avoided entirely, yet few marketing firms know what it costs to own, operate, and maintain company trucks. Fleet records, if they exist, are usually incomplete, lack timeliness, and are too general for use in planning and effective decision making.

Furthermore, many agribusinesses need help as they search for more efficient assembly and delivery operations. Severe traffic congestion, restrictive unloading hours, small orders, frequent repeat deliveries, duplication of services, and cross hauling can become a managerial nightmare. Given the tools to work with, Extension marketing specialists can increase their contribution to improved food marketing in the area of transportation economics and management.

Management of Company Fleet Expense

Several demonstrations were conducted with marketing firms to point out methods of increasing managerial effectiveness over private trucking operations. We were able to document excessive and unnoticed repairs to individual vehicles. For example, one truck operating 27,000 miles in a 17-month period required three rebuilt engines at a parts cost of $867.67. In one dairy, we estimated the potential savings in repair costs at 25 percent. Needless to say, after top management verified their repair costs and considered the downtime involved, they became especially interested in fleet cost control.

Vehicle and fleet repair problems were diagnosed or confirmed by a truck manufacturer's service representative. Extension recommendations usually included preventative maintenance inspections and operations and the adoption of routine simple records and reports.

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Results of the demonstrations were made available to at least 300 agribusinesses through a series of workshops held in Pennsylvania and nearby states. According to Extension commodity marketing specialists who assisted in the workshops, many companies were represented by operations people who have direct responsibility for fleet activities. Requests were received for additional information on fleet management. A publication, made possible through the Farmer Cooperative Service and The Pennsylvania State University, was developed to help those who wanted guidelines for controlling truck-operating costs [1].

Last year six Pennsylvania poultry processors registered 99 vehicles in a demonstrational truck-records program. This one-year program was designed to provide industry with data for review of maintenance practices on specific groupings of equipment, an indication of operational practices, and a basis for discussing specifications for new equipment. Each month individual truck operating expenses were recorded uniformly and mailed to the Extension Service. Cost per mile comparisons according to vehicle type, use, and age were developed. Cooperating firms requested expansion and continuation of the program for another year.

Management of Routing Company Trucks

In recent years there has been considerable development of mathematical procedures for more efficient routing and scheduling of trucks. Unfortunately, presentation of these techniques has often had a high "fog" index," so that the busy executive has been left confused as to how to apply them to his own operations.

Last year Schruben and Clifton [2] unveiled a truck-routing procedure that produced potential distance savings from 8 to 12 percent when applied to the actual routes used by agribusiness. While the theory involved rests upon mathematical analysis, the Lockset procedure can help dispatchers design delivery routes quickly and simply. Better procedures may improve services to customers, reduce delivery costs, and contribute to market development.

The Lockset method was field-tested with a Pennsylvania grocery chain to evaluate its potential in achieving economies in delivery operations. By this procedure, the stores and the vehicle to be included on a given route were selected and the most favorable sequence of stops determined. Ex post routing discovered by the new program were then compared with the actual delivery results.

The results were encouraging. Routes discovered by the new method produced potential savings every time. Top management, encouraged by the outcome, decided to implement the new system. Operations personnel concurred that the deliveries for the specific day were accommodated with one less truck and driver and 160 minutes less driving time. Savings were estimated at $70 for the day.

This venture turned out to be just the beginning. A traffic manager was hired to tackle immediately the most difficult problems in scheduling and transporting. His attention has been directed to advance planning, i.e., to establish optimum schedules for all delivery to 18 supermarkets and to develop and implement a program in fleet cost control.

A delivery strategy that optimizes delivery cost and frequency of service has probably not been achieved. Although solutions for three assumed patterns of produce and dairy delivery were compared using the Lockset method, the smooth interface of delivery with store ordering, data processing, and warehouse selecting has not been accomplished. Routing and scheduling decisions cannot be optimized when only partial physical distribution and information considerations are available.

The Lockset model can be used to explore the effect of alternatives, such as changes in vehicle capacity or availability, changes in demand patterns due to seasonal variations, or the addition of a new store or a new market territory. As with other operations research activities, complex systems are most easily handled with a computer.

Team Approach Essential

The demands by agribusinesses for answers to complex physical distribution questions require the team approach. Today's technological advancement involves teams of specialists; it can't be done otherwise. The industry can help by collecting and providing the input information needed.

If we are systematically to examine and contrast the performance of "what is" with "what might be," a coordinated approach to physical distribution and transportation problem solving is essential. In this way we are more likely to improve the performance of the agricultural marketing system by providing a more efficient transport route for agriproducts.

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Education for Institutional Food Service—On Wheels

JOHN M. WELCH

IT gives me much satisfaction to be able, at long last, to bring to the attention of the agricultural economists of this nation some concept of a major market for agricultural products that has been long and flagrantly neglected, some of the vital characteristics of this market, and a suggested method of reaching the numerically largest portion of it through the Extension service.

I refer to the great market of public food service and lodging. It is defined as comprising all establishments serving food for immediate consumption and/or lodging accommodations outside of the home. This industry is the fourth largest in dollar volume of sales and the third largest employer of labor in the United States [1]. Its composition, in terms of types of establishments, is shown in Table 1 [3]. In 1966 it consumed agriculturally produced food products to the value of over 22 billions of dollars [4], and employed over 2.1 millions of people [1]. Its continuing rate of growth is shown in Table 2 [1, p. 3]. While no statistics are available for the acres of textiles that food service and lodging establishments consume annually in sheets, pillow cases, towels, uniforms, draperies, upholstery, etc., or for the miles of carpet they use, it is apparent from even a casual examination that this consumption must be a significant factor if the market for agriculturally produced fibers.

I am amazed and often disheartened that a market of this magnitude and importance for agricultural products has received so little attention from either agricultural economics or the Extension service. This neglect may be caused by the high segmentation of the industry, which is composed primarily of small volume units, largely independently owned and operated. For example, in my own state of Missouri, the composition of the food service segment for 1963 [5] is as shown in Table 3. It will be interesting to compare this with the 1968 Census when that becomes available.

Please note that of the 4,619 food service establishments open for the entire year, 708, or about 13 percent, had *no* payroll (i.e., were family operated), while an additional 2,000 had fewer than four paid employees. These comprise over 58 percent of the total number of establishments; and, while they made slightly less than 20 percent of the total sales, they are numerically a significant part of the market.

JOHN M. WELCH *is extension specialist in food service management at the University of Missouri.*

Table 1. Composition of the food service industry, 1966

	Establishments		Gross food sales		Daily transactions	
	number	*percent*	*billion dollars*	*percent*	*millions*	*percent*
Public eating places	343,749	93	18.5	84	85.6	82
Institutions	27,645	7	3.4	16	18.3	18
Totals	371,394	100	21.9	100	103.9	100

A 1960 survey of the owners and managers of restaurants in Missouri showed (1) that the average level of education was tenth grade; and (2) that success in the industry, as measured by unit sales volume, correlated at the one percent level of confidence with the formal education of the owner or manager [2, pp. 8–9]. It would appear that these people badly need educational and technical aid.

Furnishing this aid, however, is complicated by the fact that owners and managers, of the smaller places, which comprise the majority of the industry, perform a significant part of the technical or skill operations. Therefore, they find it difficult to absent themselves from their businesses to attend educational activities, even when such activities are highly decentralized to Extension centers. In this respect, they are quite similar to the small family farm with which the agricultural economist is familiar.

"If the mountain will not come to Mohammed, Mohammed must go to the mountain." In this case, if agricultural economics marketing education function is to reach these people, the Extension economist must go to their individual places of business. This has been a major problem in communication. It is complicated by the fact that each industry unit is in itself an entire marketing enclave. It receives raw or partially processed materials, transports, stores, processes, packages, sells, delivers, services, collects its bills, and disposes of its wastes—all within a small circumscribed area. It deals in the most perishable of products. Its timing schedule is arbitrarily fixed by custom in peaks and valleys of activity.

The extent of this marketing enclave indicates the number of managerial and technical skills required for success in this highly competitive in-

Table 2. Sales and employment, public eating and drinking places, 1964-1969

	Year						Percent change	
	1964	1965	1966	1967	1968[a]	1969[a]	1967–68	1968–69
Sales (million dollars)	19,577	21,423	23,408	24,812	27,375	29,290	+10	+7
Employment (thousands)	1,848	1,988	2,118	2,193	2,281	2,349	+ 4	+3

[a] Estimated.

Table 3. Employment statistics, Missouri, 1963

	Establishments	Sales	Payroll
	number	*thousand dollars*	
Open entire year	4,619	285,462	68,194
Paid employees:			
None	708[a]	8,632	—
1–3	2,000[a]	41,439	7,226
4–7	986	47,739	10,571
8–19	595	58,733	15,490
20 and over	330	110,919	34,907

[a] These two categories comprise 58 percent of all establishments.

dustry—knowledge and skills that the great majority of its practitioners are seriously lacking. And this lack results in the high mortality characteristic of the industry.

When an Extension specialist does reach these people, it is a problem to have on hand the right forms, references, demonstration, instructional, and training aids to meet the specific problems of each individual.

While in Europe on sabbatical leave recently, I purchased a Volkswagen camper in order to be free of schedules and of the tyranny imposed by hotel reservations. Returning to the United States, I converted it to a mobile office-classroom. It is identified by a sign in the wardrobe window (next to the curb when the vehicle is parked) as the University of Missouri's "Food Service Program Mobile Consulting Clinic."

With its wide opening side doors, its work tables and utensil racks, backed by a refrigerator for perishable food supplies and supplemented by a two-burner propane stove, a complete set of cooking utensils, a ten-gallon water tank, and service for six persons, the mobile unit provides a facility for food production demonstrations.

A convenient electrical connection and an extension cord provide electricity for the operation of visual aid apparatus—projectors of all types.

The main cab seats five persons comfortably for small class work; its top is elevated to provide comfortable standing height for the instructor.

A folding table may be utilized for instruction in service or as a desk for managerial consultation.

Drawing equipment is carried for layout and design applications.

Library shelves have been provided in the rear compartment for necessary references, forms, tables, and texts.

Other equipment carried includes a portable typewriter, a compact dry copier, a folding work table, a small blackborad, and a small projection screen.

Equipment not in instructional use may be cleared from the main cab to the rear compartment, the driver's compartment, or to a hammock stretched over the driver's seat.

On occasion, the Extension specialist may use the comfortable bed for quarters, particularly when working in our beautiful Ozark vacation area.

I drove the machine with all equipment to this conference; it will be on display during the break, at which time I shall be glad to answer any questions about it and its use.

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VIGNETTES: POLICY–PAYMENT LIMITATIONS

CHAIRMAN: JOHN O. DUNBAR, PURDUE UNIVERSITY

Payment Limitation: Effect on Supply Adjustment and Income Distribution*

RUDIE W. SLAUGHTER, JR.

MY assignment is to present in ten minutes some possible effects of farm program payment limits on production adjustment and income distribution. There is little time for preliminary remarks, but I must disavow any intent to state a case either for or against payment limitations per se.

Payments to farmers in our present set of farm programs have at least three functions: (1) compensation for public control of private assets, granted either voluntarily or otherwise, (2) income transfer, and (3) production incentive. However, the labels currently used for the several kinds of payment do not necessarily denote their function.

I am not aware of any precedent for, or egalitarian justification of, limitation of compensation for public acquisition of control of private assets. Surely, equity requires that such acquisition be fairly compensated.

A long standing precedent for limitation of income transfers indicates that farm program payments have been rationalized on other grounds. That these payments are now seriously challenged suggests that their original rationalization is at least suspect. Demands for across the board limits suggest that the challengers don't appreciate the diverse functions of the payments. It remains to be seen whether new programs now being considered will reflect recognition of the several functions of payments.

Production Adjustment Effects

From a preliminary analysis of 1968 program participation data, we can infer some effects of payment limits on production adjustment (as summarized in Tables 1 and 2).

Cotton

Table 1 summarizes the estimated impact on cotton production of three kinds of assumed limits at four levels. The estimates are based on

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* The opinions expressed are those of the author and do not necessarily express the views of FPED, ERS, or USDA.

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hypothetical but, in my opinion, probable reactions of two kinds of cotton producers: (1) those planting only that cotton for which they receive a price support payment, i.e., the domestic allotment; and (2) those planting cotton for which no price support is paid. Producers in the first group, subject to a limit on total payments from all programs or total cotton program payments, are expected to forego diversion payments and plant the non-domestic portion of their cotton allotment to other crops as the limit denies them compensation for diversion. Additionally, I would expect that the portion of their domestic allotments for which the limit would deny them price support payments would be planted to other crops. These two actions are reported in Table 1 as acres released from cotton. The second of these actions would reduce cotton production by these producers, but this reduction would be countered with production increases by the other group of cotton producers.

Table 1. Estimated cotton production impact of specified farm program payment limits

Limit: kind and amount	Producers whose planted acres: Exceed domestic allotment: Number of producers	Exceed domestic allotment: Increase	Do not exceed domestic allotment: Number of producers	Do not exceed domestic allotment: Decrease	Do not exceed domestic allotment: Acres released from cotton	Net production effect
dollars		*thousand bales*		*thousand bales*	*thousand*	*thousand bales*
Total all programs						
3,000	34,800	864	34,200	1,170	2,764	−306
5,000	23,400	774	20,300	689	1,907	85
10,000	11,400	626	8,400	283	1,004	343
20,000	4,300	437	2,400	69	428	367
Total cotton program						
3,000	30,400	831	24,300	1,444	2,772	−613
5,000	19,600	728	13,400	1,012	1,960	−284
10,000	9,300	570	5,[illegible]00	530	1,044	40
20,000	3,500	386	1,[illegible]00	230	459	156
Cotton price support payments						
3,000	27,100	765	18,400	1,494	0	−729
5,000	17,500	663	10,600	1,058	0	−395
10,000	8,100	500	3,500	571	0	− 71
20,000	2,900	327	1,400	258	0	69

Those producers planting more than their domestic allotment would, I expect, forego diversion for payment as the limit reduces their total payment eligibility. However, rather than plant their previously diverted cotton allotment to other crops, they are likely to plant it to cotton. Hence,

Table 2. Hypothetical grain production response to specified farm program payment limits

Limit: kind and amount	Production increase		
	Corn	Sorghum	Wheat
dollars	*thousand bushels*		
Total all programs			
3,000	356,100	151,100	233,600
5,000	164,400	124,100	122,200
10,000	47,600	82,400	39,400
20,000	13,700	38,100	12,600
Total each program			
3,000	350,900	122,000	183,400
5,000	136,200	90,100	88,400
10,000	36,400	43,500	24,100
20,000	8,300	13,600	7,500
Price support each program			
3,000	—[a]		
5,000			
10,000			
20,000			

[a] Blanks indicate no significant impact.

their cotton production would be increased. The cotton marketing quota would prevent them from planting more than their allotment acres to cotton. Thus, their action would not counter the cotton acreage released by the first kind of producer, although their increased cotton production would counter reduced cotton production of the first group. Payment limits below $10,000 tend to decrease cotton production, while those above $10,000 tend to increase it.

Feed grains and wheat

The hypothetical effects on the production of feed grains and wheat under three kinds of assumed payment limits at four levels are summarized in Table 2. The hypothesized reaction for feed grain producers affected by a limit is that those producers otherwise entitled to 150 percent of the limit would forego all feed grain program benefits and plant to feed grain an acreage equivalent to 120 percent of their feed grain base. For wheat farmers affected by a limit, the hypothesized reaction is that those otherwise entitled to 200 percent of the limit would forego wheat program benefits and plant acreage equivalent to 150 percent of their wheat allotment to wheat.

Both hypotheses are grossly over-simple. They are not intended as estimates of what would actually happen, but as illustrations of the probable different impacts of the three kinds of limits at varying levels.

In summary, production effects of payment limits vary by type and

Table 3. Gini ratios: Cotton, feed grain, and wheat program payment distributions, with and without assumed payment limitations, 1968[a]

Item	$3,000	$5,000	$10,000	$20,000	$30,000	No limit[b]
Cotton	.54	.61	.67	.71	.73	.75
Feed grain	.48	.52	.54	.55	.55	.55
Wheat	.53	.58	.6[illegible]	.62	.62	.62
Three programs, total	.48	.53	.58	.61	.61	.63

[a] Equal distribution yields ratio of 0; maximum is 1.
[b] 1968.

level of limit and as price relatives and benefit relatives vary. Limits below $10,000 probably would impair the effectiveness of the wheat and feed grains programs in containing productive capacity.

Payment Distribution

Analysis of the effects of payment limits on the distribution of payments requires some speculation on the real effectiveness of the nominal limit. The simple assumption is that the nominal limit would prevent accrual of more than the specified amount of program payments to current program recipients. Though this assumption is naive, the resultant payment distribution is the one which would be revealed by program payment data. A more realistic assumption is that significant avoidance of the nominal limit would occur among those payees presently receiving small multiples of the nominal limit. I know of no statistical basis for estimating the extent of such possibilities.

If pressed for a judgment on the real effect of current payment limitation proposals, I would expect the real effect to be an increase in nominal payees with only nominal effects on payment distribution and no production effect discernible in the aggregate. Should the limits be made effective by law and administration, the major impact on distribution of income, in my opinion, would emanate from truncation of farm sizes at the upper limit of payment eligibility on cotton and wheat farms rather than from altered distribution of program payments. The same would obtain for any farms realizing a major part of their incomes from program payments. The structural effect of real payment limits on such farms would be similar to the structural effects of a limit on gross or net income.

Table 3 shows Gini ratios of program payment distribution made in 1968, and what they would be under assumed limits. The no-limit ratios are calculated with 28 strata. Each of the ratios under limit is calculated with fewer strata.

Payment Limitations: The Economic and Political Feasibility*

ARNOLD PAULSEN

IN an extreme sense, payment limitations are of course feasible. We can have them if we are willing to pay the political, administrative, and economic price. The U.S. economy and the federal budget would be affected less than one percent. The votes needed on congressional committees and on the floor of the House and Senate could, I believe, be obtained one of these years for some form and level of payment limitation if a coalition of administration and bipartisan congressional leaders are willing to give its passage sufficient priority. The U.S. Department of Agriculture could administer effectively and achieve the intent of any one of several forms of payment limitations. The question is not absolute feasibility, but relative desirability: Would the consequences of specific payment limitations be judged by our policy makers as improvements relative to what we have now?

Current agricultural payments are rather highly concentrated toward large recipients (Figure 1). The concentration ratio for agriculture payments in 1968 was larger than for the United States after tax income. The concentration of payments under sugar, cotton and wheat are more highly concentrated than feed grain payments (Figure 2). All payments were more concentrated in 1968 than in 1965. The concentration is really of no concern to the economic policy goal of resource efficiency for production of agricultural products, nor is it of any concern to the expenditure efficiency of idling agriculture's excess capacity. The concern comes from the equity goal, i.e., our concern that income and wealth are more unevenly distributed than we desire [1].

The Case for Payment Limitations

Payments could be limited in many ways; for example, for few or for many of agriculture's programs [7]. The commodity program of cotton, wheat, and feed grain are most frequently discussed, but wool and sugar, rice, and soybeans are also candidates. Payments under programs for land improvement (ACP) or land diversion (CRP, CAP, or CCP) could also be limited. Payments might be limited to each farm or to each individual producer (person) or to each family. The limit might be placed at

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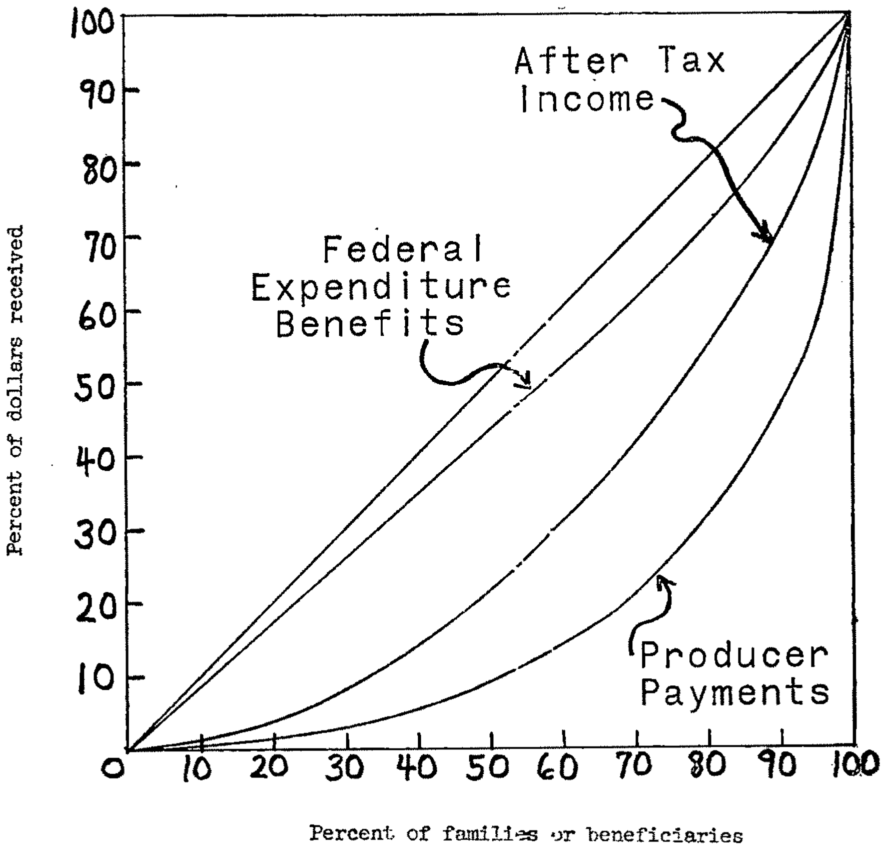

Figure 1. **Lorenz curves for all produce payments except wool and sugar, 1968; after tax income received by families, 1965; and all federal expenditure benefits including social insurance, 1961**

Sources: Produce payments, [5, p. 15, Table 6]; after tax income, [6, p. 135, Table D-4]; federal expenditure benefits, [8, p. 50, Table B-10].

$20,000, or $10,000, $5,000 or $3,000. The payment limitation could apply only to price support direct payments (e.g. 14.74 cents per pound on 65 percent of allotment for cotton) [11], or be applied also to voluntary land diversion payments, (e.g., 50 percent of county loan rate times normal farm yield for wheat [10]. One could go on and limit the dollar volume of price support loans (e.g., $1.05 per bushel non-recourse loan on corn) [9], or extend the limits even to cost sharing payments for land improvement and conservation measures (e.g., 25 percent or more of the cost of providing more stock water on grazing land]. There are potentially a large number of possible alternative payment limitation plans.

Three schemes for payment limitations, representing radically different purposes and using different combinations of features, are listed below. They are arranged in descending order of total budget cost and tendency to preserve the status quo and in ascending order to their tendency to limit transfers in favor of the wealthy and give assistance to the very poor.

Plan A. A limit of some relatively small size, say $5,000, to any one farm for price support direct payments from each of the wheat, cotton, or feed grain programs.

Plan B. A larger limit, say $20,000 of total payments, to any one individual producer (a person) from all forms of agricultural payments, i.e., price support payments plus price support loans plus diversion payments plus cost share payments under all types of programs (wheat, cotton, feed grains, sugar, wool, peanuts, rice, soybeans, dairy, ACP, CAP, CCP, etc.).

Plan C. Establish a 2- or 3-billion dollar "negative income tax" for all

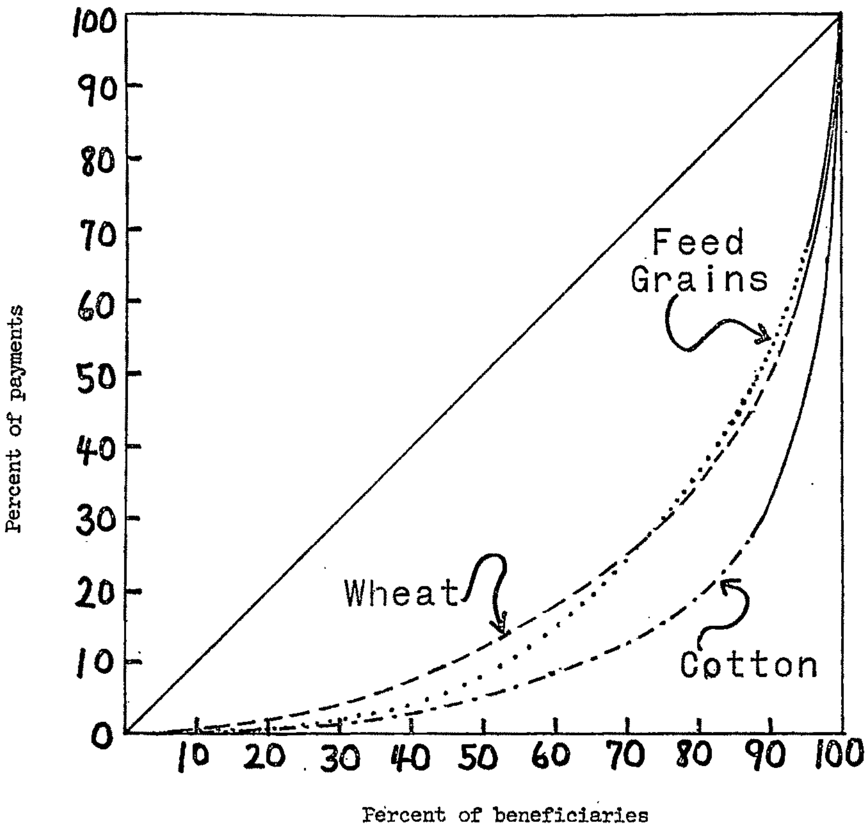

Figure 2. **Lorenz curves for cotton, wheat, and feed grain payments, United States, 1968**

needy farm families which would guarantee, say, $1,000 per year per dependent. Remove all other price support, land diversion, and investment cost sharing programs.

Plan A would reduce the range and average size of individual checks for direct income supplement. Probably fewer than 100,000 $5,000 checks would be required at first [4]. This would improve the public image of the agricultural price support programs. Individuals could still own several farms. It would still be possible, and not more expensive than now, to idle excess capacity through acreage diversion. It would be possible to support prices through production control and thus the United States could still strive for the standard of a rate of return for resources on large, well-organized farms equal to opportunity cost. The general price of land currently could be maintained. Government stocks could still be used to reduce price swings. The total treasury or government cost would be reduced. Smaller producers would still be able to participate fully in the two-price system now in effect. All could receive market prices at about the world level, but small farms could receive a price supplement by direct payment.

Plan B, with a $20,000 limit on all payments would result in only about 10,000 individuals receiving checks as large as $20,000 [5]. With high speed computers carefully compiling all payments to the same social security number, no one would need to receive more than $20,000 in total in one year through the Department of Agriculture. Two or more individuals of the same family could operate farms, of course, and each obtain a $20,000 check. With Plan B it would probably still be possible to idle enough total capacity by voluntary land diversion to maintain world price levels, but it might be slightly more expensive because fewer large marginal acreages that could be retired at low unit cost could be rented.[1] Land prices would fall, especially in areas of large holdings and specialized production of a supported crop, e.g., cotton or rice, with no close competing alternative [2]. The payment limit would become another restriction or resource for profit maximization, like land, capital, and labor. Farmers would need to learn to budget for the best use of their allotment of $20,000 of payments each year.

Plan C would place the entire basis for receipt of payments upon a criterion of need for disposable income. The poor would receive an income supplement regardless of what they produced. If his total income from all sources exceeded the poverty level, the large farmer would not receive any payment no matter how low farm prices fell. Under this plan it might be possible to completely free the agricultural markets for products and inputs from government intervention and do very little harm to small producers' level of living. If total incomes from all sources for a farm family, as reported on the income tax form, fell below the poverty level, a supplement would be sent to make up a portion of the difference between the earned income and a poverty line. The cost of providing income to the poor would be not over $1.10 for each dollar received, compared with $6–18 per dollar received now [11].

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[1] This increase of supply control cost might exist only in theory because in actual practice the diversion payment recently has been nearly constant per bushel or bale of normal yield on all grades of land.

The U. S. excess capacity in agriculture could not be idled under Plan C, and full employment of agricultural resources would probably result. Lower product prices would follow but so would a strong competitive position for U. S. products in the export markets. With Plan C, generally lower land values would result, slightly lower consumer costs and a low rate of return to farm resources, especially on small poorly organized farms. Probably, resource return would also be below opportunity cost on large well organized farms, at least for a few years. Many land owners would find their net worth sharply decreased; some low equity farmers might even be bankrupt. However, the flow of farm products and gross national product and the purchase of most farm inputs would probably remain essentially unchanged.

A Political Deadlock Over Payment Limitations?

The clamor for payment limitations comes from a relatively new bipartisan coalition of large city congressmen who desire assistance for urban and low income problems and see large farm program costs plus payments over $20,000 as competitive for funds and as help for the rich rather than the poor. The resistance to payment limitations comes from the rural part of the west, southwest, and southeast. These areas and their representatives have respect for the big operator and for property rights and asset value. The commodities with most concentration are sugar, rice, and cotton, and the areas of most concentration of large-scale producers in general and especially of these commodities plus wheat and grain sorghum are in those dozen or so states rimming the United States on the west from Hawaii and California along the south to Florida and South Carolina on the east, plus Nevada and Arkansas. The senators and representatives from these states, whose large producers would be most adversely affected by payment limitation, hold influential positions on congressional agriculture and appropriations committees. Thus, while passage of payment limitations would seem to be quite feasible in a national popular referendum, it is not politically feasible in the agriculture committees and subcommittees of the Congress. A deadlock could develop if payment limitations cannot pass the Senate or congressional committees, and new farm legislation cannot pass the House without payment limitations next year [3].

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Payment Limitation: Pros and Cons as Seen by Farm Organizations

W. E. HAMILTON

THE limitation of payments under government farm programs is a matter of concern to general farm organizations and organizations based on commodities with payment programs.

The National Association of Wheat Growers says limitations "would be unfair and discriminatory and would encourage widespread noncompliance and disrupt effective supply control" [3].

Delegates to the 1969 meeting of the National Cotton Council of America recommended that the Council:

> Oppose any governmental action which would place a maximum dollar limit upon any farmer's participation in, or benefit from, a price support program or payment program. . . .

This action was supplemented by the adoption of "guidelines" for future consideration and action which call on the Council to:

> Recognize that in the immediately foreseeable future, some form of cost adjustment must be provided in order for producers to sell (cotton) at a competitive price and receive a reasonable return for labor, management and investment;
>
> Provide that such cost adjustment be made to the commodity rather than to the producer, and that such adjustment be made on all bales actually produced on the acreage allotted for that season. . . . [4, pp. 4 and 3].

The Council, which includes processing and handling groups, apparently is more concerned with getting cotton produced than with the claim that limitations would "disrupt effective supply control." This view is clearly set forth in a statement by Council economists, Horne and Wellford:

> *Subsidy* is an ugly word, but the purpose of the subsidy is to help a great industry survive and work its way toward a better position by taking advantage of its tremendous opportunities to improve efficiency and expand markets. This kind of subsidy is needed just as much by big producers as by medium and small producers. It cannot be judged by the standards of a poverty program. The large producers, who get corresponding large payments, are not receiving any outrageous hand-out of government largess any more than the rest of the producers. There have been a number of studies by recognized authorities, indicating that the larger producers have no great cost advantage over efficient growers with

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> a few hundred acres. Since the subsidy is needed now to cover costs and a minimum return, a government policy withholding it from the larger producers would represent a government decision to put them out of business. . . . [2, p. 33].

The National Wool Growers Association views limitation proposals as "efforts to eventually kill present farm programs." It says that "limitations are economically unsound in any farm programs . . . and would create serious economic hardships" for wool. It also says that large flocks are necessary to provide economic units in semi-arid regions and that forcing large producers to liquidate would be inconsistent with the National Wool Act objective of "maintaining and increasing production of a deficit commodity" [7].

The National Sugarbeet Growers Federation takes the position that the limitation issue has been recognized by the scale-down provisions of the Sugar Act; however, it is opposed to any limitation. The Federation notes that sugar payments are made to producers for cooperation "in carrying out specific and well defined Governmental objectives," and says that an excise tax has been imposed on sugar to finance these payments and that a limitation would be "untenable" without removal or reduction of this tax [6].

The position of the National Grange is as follows:

> In order to have effective supply-management, we must have 'compliance' and participation by the producers of food and fiber, regardless of their size. The payments being made pursuant to the farm program are an integral part of supply-management and necessary to obtain producer compliance [5, p. 17].

The National Farmers Union favors a graduated system of limitations which calls for full payments up to $25,000, 75 percent of the next $10,000, and 50 percent of the next $10,000. This works out to a maximum total limitation of $37,500 for producers who otherwise would be entitled to payments of $45,000 or more.

In support of this position, Reuben Johnson, NFU director of legislative services, told the Senate Subcommittee on Agricultural Appropriations that:

> . . . we faced up to one of the toughest decisions that a farm organization like ourselves has had to make in a long time. . . .
>
> We didn't want to interfere with the workability of the farm commodity programs, yet we recognize we have a very serious problem, also somewhat political in nature. Therefore, we have decided on a graduated formula, to put a limitation on payments. It was a controversial issue at our convention, and there was a heated discussion of it [8, p. 1581].

The organizations thus far quoted generally favor existing government programs including direct payments. The American Farm Bureau Federation has proposed amendments to the Food and Agriculture Act of 1965 that would discontinue government payments and government supply-management programs for feed grains, wheat, and cotton effective with 1975 crops [1, p. 41].

Payments would be phased out by reducing the total amount used for this purpose for 1969 crops 20 percent per year for five years, with no limitation on payments to individuals during the phase-out. Effective with the 1971 crops, loan rates for wheat, cotton, feed grains, and soybeans would be limited to not more than 85 percent of the previous three-year average market price. Also effective in 1971, the government would be prohibited from selling CCC stocks of these commodities at less than 150 percent of the current loan rate plus carrying charges, except when sales are offset by equivalent purchases in the open market.

The Cropland Adjustment Program would be modified to require emphasis on the retirement of whole farms and the use of competitive bids to determine the land that is to be retired. The Secretary of Agriculture would be directed to retire at least 10 million acres per year for five years under this modified program.

A special transitional program would be instituted for farmers with gross annual sales of farm products of not more than $5,000 and average off-farm income of not more than $2,000 (including income of both husband and wife). Such farmers would be eligible to receive one or more of the following:

(1) Compensation for acreage allotments and base acreages surrendered to the Secretary for permanent cancellation.
(2) Retraining grants of not to exceed $1,000.
(3) Adjustment assistance of not to exceed $2,500 per year for two years.
(4) Loans under existing credit programs to further facilitate the transition of eligible farmers to more gainful employment.

Farm Bureau policy emphasizes the use of payments to get long-term adjustments in agriculture through land retirement and adjustment assistance to low-income farmers rather than to supplement commodity prices. This approach would largely, but not entirely, eliminate the limitation issue. The payments proposed to assist low-income farmers are relatively small. Payments made for the retirement of land on a bid basis would clearly be payment for performance, and the pressure for large units to participate would be much less than it is under commodity programs.

It may seem inconsistent to some that Farm Bureau should oppose limitations on commodity program payments when it seeks to phase out these programs. This is not necessarily so. Farm Bureau has long cited the "inevitability" of limitations as a reason for opposing commodity payments. It had argued that certain features of supply-management programs—such as acreage restrictions, the use of CCC stocks to limit price advances, the effect of guaranteed returns on per-acre yields, and the natural desire of administrators to protect themselves against responsibility for shortages—restrict individual opportunity and reduce farm prices below the free market level. The inclusion of limitations in such programs would be unfair because large operators do not have the alternative of producing for a truly free market.

In summary, organizations covered by this survey, with one exception, oppose the limitation of payments. The one organization that favors limitation supports a graduated system that would permit payments well above the $20,000 ceiling approved by the U. S. House of Representatives on two occasions. Farm organizations whose policies favor existing programs contend that government payments are earned by farmers. Consequently, they uniformly reject the type of limitations that would be dictated by the standards of a poverty program.

In its opposition to current programs, Farm Bureau argues that supply-management programs affect prices and costs in ways that make it unprofitable to produce without payments and that limitations would place a ceiling on opportunity in agriculture.

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VIGNETTES: EMPIRICAL STUDIES

CHAIRMAN: LEO V. BLAKLEY, OKLAHOMA STATE UNIVERSITY

Consumer Knowledge for Sovereignty: Apples

LYLE SOLVERSON

IN the theory of consumer choice, the equilibrium solution represents maximum satisfaction because perfect knowledge is attainable and all alternatives have been considered. In real life this peak of satisfaction is out of reach because the typical consumer does not have available all the information needed to make such a decision. In the purchase of food products, the typical consumer does not have adequate information concerning quality, relative benefits of various brands and comparative nutritional values of substitute products. Furthermore, in the dynamic food industry, consumers would have to review and revise each purchase whenever any change occurred in the market, thus setting in motion an impossible information gathering procedure. Since securing additional information may be costly relative to benefits, the consumer operates with imperfect knowledge.

The question then becomes, what does the consumer base his choice upon? The information available to a consumer varies widely, depending on the commodity considered. One class of information is the objective but somewhat general reports from government or academic organizations.[1] For the most part, however, such sources tend to provide only background information and cover only a limited area of consumption expenditures. Information also comes from the less objective service publications, periodicals, and consumer testing organizations. However, none of these sources is systematically collected or presented in a form to meet the needs of many consumers. While both classes of information are available to all consumers, they are not generally used by the majority of consumers.[2]

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[1] Some examples are: (1) U.S. Department of Agriculture, *How to Buy Poultry,* C&MS Home and Garden Bul. 157, July 1968; (2) U.S. Department of Agriculture, *Fruits in Family Meal, A Guide for Consumers,* C&MS Home and Garden Bul. 125, Jan. 1968; and (3) U.S. Department of Agriculture, *Apples in Appealing Ways,* C&MS Home and Garden Bul. 161, April 1969.

[2] As an example, in the consumer interview conducted in St. Louis, Missouri, only 18 percent of the consumers stated they knew of any informational bulletins or pamphlets on apples.

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Table 1. Number and percent of consumers rating various purchasing characteristics very important, fairly important, and unimportant

Purchasing characteristic	Very important		Fairly important		Unimportant		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Lack of bruises	414	87.7	58	12.3	0	0.0	472	100
Lack of blemishes	294	62.1	159	33.5	21	4.4	474	100
Variety	285	61.4	142	30.6	37	8.0	464	100
Color	152	32.5	243	52.0	72	15.5	467	100
Size	66	14.0	273	58.1	131	27.9	470	100
Type of package	97	20.8	164	35.2	205	44.0	466	100
Brand[a]	48	10.3	86	18.4	333	71.3	467	100

[a] State of origin.

For the individual consumer, the most used and informative information is often his own experience with a given product. The importance of past experiences cannot be overlooked in analyzing factors affecting consumer choice.

This study dealt with the degree of importance of certain product characteristics in the purchase of apples. It sought to determine the relative importance of four kinds of attributes—quality, appearance, type of package, and "brand"[3]—in the purchase of apples. In particular, it was concerned with the relative importance of state of origin, or brand.

Source of Data

The data reported in this paper were collected through consumer interviews and mail questionnaires returned by the interviewees in six grocery stores in St. Louis, Missouri, during the spring of 1968. Additional data were collected by direct observation of consumer purchases within the same stores during the same time period.

Factors Considered in the Purchase of Apples

In the mail questionnaire, consumers were asked to rate seven factors that might have an influence on his purchase of apples: (1) lack of bruises, (2) lack of blemishes, (3) variety of apple, (4) color of apple, (5) size of apple, (6) type of package, and (7) state in which the apple was produced. Their responses are shown in Table 1.

Three of these factors may be considered as affecting or acting as proxies for quality and/or taste: lack of bruises, lack of blemishes, and variety of apple. These factors were considered to be very important or fairly important by 100 percent, 95.6 percent, and 92.0 percent of the respondents, respectively.

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[3] Since a product may be differentiated by state of origin as well as by a brand name, "brand" is used here synonomously with state of origin.

Size and color of apples may be regarded as factors of appearance.[4] A smaller percentage of respondents considered size and color (71.2 and 84.5 percent, respectively) of some importance in their selection of apples.

Although the type of package is a factor not directly associated with the product, 56 percent of the interviewees considered packaging to be of some importance in their decision to purchase apples.

State of origin may be considered a factor not directly related to quality of product but may be one method of product differentiation. Only 28.7 percent of the respondents considered this to be an important factor in their selection process.

It appears from this sample that consumers put greatest weight on quality in the purchase of apples. Appearance of the product is also an important attribute, while characteristics external to the product (type of package and state of origin) are not as important in the consumers' decision process.

While the questionnaire results seem conclusive, Padberg et al. point out that problems may be encountered with consumer questionnaires "... when consumers are encouraged to explain motivations which they do not understand," or when "... questions may cause consumers to respond in a way that is different from customary behavior, in order to make their actions seem 'rational' " [1, p. 724].

Because of the importance to producers of the effect of state of origin on consumer purchases, the purchase of different brands of apples by consumers was observed directly. Red delicious apples of comparable size, quality and color were placed in a display with equal frontage given to the following three brands: (1) Washington Red Delicious apples, (2) Michigan Red Delicious apples, and (3) Red Delicious apples with no state of origin designated. An attempt was made to neutralize all factors affecting purchase of apples except state of origin. An audit was taken in each store at the end of each day. One observation consisted of the percent of apples taken per day of a given brand of apples. With equal display space and quality and equal prices, it was hypothesized that the sales of each brand would also be equal if there there was no preference for a given brand. Conversely, it was hypothesized that if there was preference for a given brand, the sales of that brand would be significantly higher than one-third of total product sales. The average percent of apples taken were: (1) 33.67 percent, Washington; (2) 33.61 percent, Michigan; and (3) 32.72 percent, unbranded.[5] Based on both consumer answers and observed consumer behavior, it may be concluded that state of origin appears not to have an influence on purchasing behavior.

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[4] In some cases, these two factors may also be considered as proxies for quality.

[5] A one-way analysis of variance was used with state of origin as treatment. The *F* ratio was less than one and, of course, insignificant.

Conclusions

If the three factors, blemishes, bruises, and variety, do in fact represent quality and taste of product, and the other factors do not represent quality and taste to the consumer, it may be concluded that consumers put a heavier weight on quality and taste factors than on appearance and factors external to the product in making their purchasing decisions.

An important implication to apple growers, based both on consumer answers and observed behavior is that state of origin, by itself, has little effect on consumer purchasing decisions.

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Louisville Produce Terminal: Its Changing Trends and Potentials, 1966-1975

B. Russell Robertson and Harold G. Love

PRODUCE terminals have long been an integral part of our agricultural system. It was there that producers could assemble and market their perishable products directly to various kinds of buyers. Over the years, produce terminals have been dynamic and colorful institutions rendering an essential service at competitive costs. Within recent years, however, the marketing system has been undergoing an evolution that is making marked changes in the way terminals do business.

The Louisville Produce Terminal is unique. It is not municipally owned or operated. It is a private corporation, with most of the stock held by firms operating on the terminal. Since its inception, the Terminal has experienced difficulty in determining whether its primary objective is to render some return to stock or to provide a least-cost facility for its tenant landlords. These two points of view are not entirely compatible.

Like many others, the Louisville Terminal continues to experience pains of competition and the shifting modes of doing business. In a sense, most terminals are relatively less important than they used to be. They have been displaced partially by another type of marketing system, because of (1) a shift to shipping point procurements by large buyers; (2) standardization of grades and packaging under the auspices of federal inspection; (3) forward pricing by large commercial farms dealing directly with large wholesale distributors; (4) centralization of district warehouses and prepackaging centers by corporate chains; (5) the decline of locally grown produce; and (6) the decline of "papa and mama" stores in favor of the supermarket. These changes are evidenced by the fact that the produce firms remaining in business on the Terminal tend to be larger but fewer. As firms specialize in products handled or services rendered, their sales volume increases. In the face of these changes, the management of the Louisville Terminal became concerned with the question of what lies ahead in the next decade.

As a result, the University of Kentucky Department of Agricultural Economics was requested to examine the demand and trends for terminal services, to delineate the market area, and to estimate its probable magnitude. To do this, commercial buyers and consumers were arrayed by zones radiating out from Louisville; e.g., Zone 1 embraced customers within a 50-mile radius, Zone 2 extended from 51 to 75 miles, and

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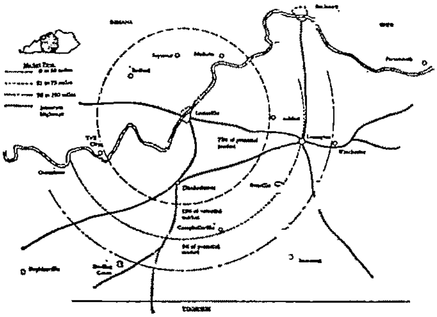
Zone 3 embraced an area 76 to 100 miles of Louisville (Figure 1). These zones, when analyzed in terms of number of consumers, indicated that 72 percent of the total population to be serviced by the terminal reside in Zone 1, 19 percent in Zone 2, and about 9 percent in Zone 3 [1]. The population in Zone 3 is declining as people shift their residence towards centers of business and commercial activities.

Income related to these zones was used as a measure of market size. In Zone 1, the aggregate income exceeded $1.8 million; in Zone 2, it exceeded $463 million; and in Zone 3 it was about $200 million [3]. Obviously, Zone 1, with its concentration of purchasing power, offered the greatest opportunity for market growth. Median family income ranged from $4,300 in Zone 1 to $2,600 in Zone 3 [4], again indicating the relative concentration of purchasing power by geographical zones.

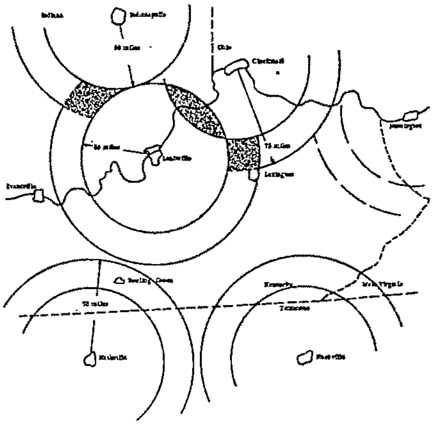
Figure 1. Percentage distribution of the projected 1970 market by market zones



The magnitude of the 1970 market can be estimated from linear projections using 1950–60 per capita consumption data and future population estimates. For the 1966–70 period, it was estimated that the market for fresh fruits and vegetables would increase by 52 million pounds representing a 9 percent increase to 634 million pounds. Obviously, the terminal corporation is interested in what portion of the estimated volume would move through the terminal rather than through some other distribution system. If the Terminal expects to capture an increasing portion of the market, each firm must recognize the question and aggressively serve the needs of its clientele.

Another factor affecting the terminal market is the number of retail stores in the market area that sell fresh fruits and vegetables. This number tends to decline as we move away from the primary zone. In 1966, the ratio of families per store varied from 160 in Zone 1 to 100 in Zone 3 [2].

Figure 2. Intermarket relationships and mileage zones



The study indicated growth would occur in public eating establishments, restaurants, drive-ins, schools, and institutional cafeterias. This expanding market sector will provide an excellent opportunity for aggressive service wholesale firms.

Size of orders were a major economic problem of produce firms. All too frequently, many terminal firms were hampered by small order deliveries, multiple stops, excessive handling, and pilferage, all of which eroded profits. There was therefore a need to analyze their physical distribution systems. As a consequence, some firms have changed their warehousing and handling methods, their modes of transportation and routing systems. These firms have reduced costs and, in many cases, customers have received an increased level of service.

We would be remiss if we failed to recognize the existence of intermarket competition, e.g., between Louisville and Cincinnati [Figure 2]. The market area was assumed to be primarily a function of distance. These boundaries are located midway between markets except when other factors such as quality of service or price and non-price concessions to customers pave the way for expanding the market area served. In these cases, a given firm can invade another market area. This has been happening in the Louisville market.

These are but a few of the highlights of the study. Although the findings indicate that the Louisville market will continue to undergo a significant change, they also foretell of opportunities whereby, sound, well managed, and aggressive business firms can achieve economic progress, provided they recognize the problems and proceed to solve them in a rational and economic manner.

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The Economic Feasibility of an Integrated Broiler Operation

Richard W. Schermerhorn

THE objective of this paper is to discuss methodology used in conducting feasibility studies, using as an example an integrated broiler operation consisting of the following individual segments: a processing plant; a feedmill; a hatchery; a broiler production program; and a hatching egg production program.

Because of time limitation, I shall concentrate the discussion on the analysis of what I call "directly influencing factors." However, I should stress that in a complete feasibility study such general environmental conditions as population characteristics, community services, form of government and taxation, and the availability of education, health, and communication facilities should be analyzed relative to specific site location.

The analysis of directly influencing factors forms the basis of any feasibility study. It is generally required as a part of loan applications and is used to show whether or not the proposed operation can survive economically. Directly influencing factors are divided into three groups: (1) marketing; (2) raw material supply; and (3) production process. I shall limit discussion of the first two groups to a brief overview and place major emphasis on analysis of the production and/or processing elements of the proposed operation.

Analyzing the market feasibility of a project is usually the most difficult phase of the study. Usually, one prepares a comparison of local consumption and local production. However, we know that ready-to-cook broilers in ice or frozen form commonly reach markets within 1,000 miles or more; hence, we must analyze the national market situation, including production, consumption, cold storage holdings, and price trends. The difficulty in conducting the market feasibility study now becomes evident, i.e., the national and/or local market situation cannot insure that the firm can supply the quantity and quality of birds demanded by any given buyer, and the firm must deal with the buyer. Therefore, I generally interview prospective buyers and attempt to obtain commitments for the specified quantities and qualities that the processing plant will produce.

The second major item to be considered in any feasibility study is the economic availability of the various raw material supply items required in the operation. In the example "integrated broiler operation," it is a relatively simple task to insure, at least on paper, that these items are pro-

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vided to the operation because the major input items to the various individual segments of the integrated operation are provided by one of the other segments. Further, it is relatively simple to determine the specific quantities of raw materials that will be required. For example, to produce 160,000 ready-to-cook broilers weekly will require the receipt at the processing plant of 165,000 live broilers; to produce this quantity of live broilers weekly will require a placement of 174,000 chicks weekly; to hatch 174,000 chicks weekly will require a weekly egg set of 210,000 eggs; and to set 210,000 eggs weekly will require a breeder flock of 83,000 breeder hens.

The economic availability of these raw material supply items for an integrated broiler operation depends primarily upon management's ability to schedule the production requirements of each segment of the operation and insure that this scheduling is carried out.

The third item to be examined in all feasibility studies is the production process itself, including an analysis of the availability of a dependable labor force, utilities, water, and sewage. Further, and most important in conducting any feasibility analysis, is a determination of the potential costs and returns that can be realistically achieved by the operation. To adequately determine this, one must determine capital investment requirements, operating capital requirements, costs of operation, and projected income.

In my feasibility studies, the following types of information are presented in the final report. First, operating cost budgets are presented; for the integrated broiler operation, this includes budgets for the processing plant, the broiler production program, the hatching egg production program, the hatchery, and the feedmill. A personnel projection need also is prepared for the entire operation—especially important today because many of our feasibility studies are conducted as a part of an Economic Development Administration or Small Business Administration loan. In these cases, the employment that the operation will generate in the area is one of the major factors determining whether a loan is granted.

Next, the data in the budgets are summarized to determine the specific investment needs, cost of operation, and cash needs. A projected income statement is then prepared to determine the profitability of the enterprise, and a cash flow summary is prepared in order to determine adequate levels of operating capital needed to insure the ability of the firm to meet its financial obligations. The projected income statement and the cash flow summary are, of course, the most important items in a feasibility study, both to the potential entrepreneur who wishes to analyze profit potentials and to the banker who has to evaluate repayment potentials.

The projected income statement is prepared from the operational costs and income budgets and shows the expected profit level for the operation. The level of profit will indicate the percent return on investment that the entrepreneur can expect and will show whether funds will be available to repay loans. The major annual income for the broiler operation would come from the sale of ready-to-cook broilers. In projecting this income, one must know the expected marketing weights and grades of the ready-to-cook broilers and the price variations by grade. Other sources of income would be from the offal produced by the operation, from the sale of spent breeder hens and cockerels, and from the sale of non-hatchable eggs.

With completion of the projected income statement, many feasibility studies are considered to be complete. However, it is my experience that the most important item has yet to be included—the cash flow summary. Adequate operating capital is perhaps the critical item for the successful operation of any firm, and this is certainly true for integrated broiler operations. Hence, it is necessary to prepare a cash flow summary to determine what the cash needs will be for the firm, and the sources of cash available to meet these needs. Usually a cash flow covering one year's operation on a monthly basis is adequate to show the cash needs and sources of cash available to the firm.

It should be emphasized that a cash flow summary must be complete; that is, it must include every item of expense and income to be incurred. If it does not, the firm may encounter great financial difficulty in a very short period of time. To illustrate the exactness that must be given to the preparation of a cash flow summary, I shall mention some of the items of particular importance in a cash flow summary for an integrated broiler operation: (1) chick placement schedule; (2) terms of payment by a buyer of the ready-to-cook broilers; (3) method and time of payment to the contract growers; (4) placement schedule for breeder hen requirements; and (5) credit terms for purchase of feed grain ingredients.

After all expense and income items have been considered, the real importance of a cash flow summary becomes evident because it allows one to determine: (1) those periods during which expenses will exceed income, pointing out the need for short-term cash borrowings; (2) whether enough operating capital will be generated over the long run to make loan repayments; and (3) whether interest payments on a particular loan can be met. I have also injected in some cash flow summaries, revolving fund situations which could provide additional types of financing for the operation.

In summary, a feasibility study must include an analysis of environmental conditions relative to site location, the market potential for the product, the economic availability of raw material supplies, and the profitability of the production process. The profitability analysis of the production process must include a determination of capital investment needs, costs and returns from operation, and projected cash needs and availability.[1]

Reference

[1] SCHERMERHORN, R. W., *An Economic Feasibility Analysis of Integrated Broiler Operation in Oklahoma,* Dept. of Agr. Econ. AE 6716, Oklahoma State University, June 1967.

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[1] For an example of the procedure for conducting a feasibility study and the analysis of an integrated broiler operation, see [1].

Showing a Retailer that Meat Sanitation Pays—An Economic Approach

FREDERICK A. PERKINS

DEMONSTRATION, one of the oldest techniques of Extension education, is a most useful tool for implementing research findings into real world situations. Scientific research arouses interest and provides the basis for new developments. It also poses important considerations relating to the adoption of a new practice or procedure. Among these are the evaluation of income producing potentialities, the selection of optimum methods for implementing programs, and the creation of a favorable climate for employee acceptance of new ideas.

Extension marketing specialists can be effective in bringing about change by helping management to better understand and apply the results of research. The technique used, however, needs to be more sophisticated than the mass media approach of the past. More attention needs to be devoted to providing relevant information to key decision makers that is tailored to the needs of the individual firm. In many instances the specialist will require technical aid from other disciplines in order to provide total assistance to his client.

The following example shows how research originating at the University of Missouri is being applied to promote better handling practices for prepackaged meat in New Jersey supermarkets. Conceivably, a similar effort could be used with other areas of investigation where relevant information is needed for promoting new practices and educational programs.

Background

It is generally recognized that the appearance of prepackaged meat displayed in retail stores is of significance to consumers who presume color to be an indication of freshness. Discolored packages, therefore, must be promptly removed from the display case and reprocessed, thereby adding to operating costs. Basic laboratory work reported by researchers at the University of Missouri under a USDA contract reveals microbial growth to be a major factor causing discoloration. It further indicates that the display life of prepackaged meats can be extended by proper refrigeration and sanitation practices [1]. Increased display life can provide greater profits by reducing the number of rewraps, thus involving less labor, less material waste, and less product loss.

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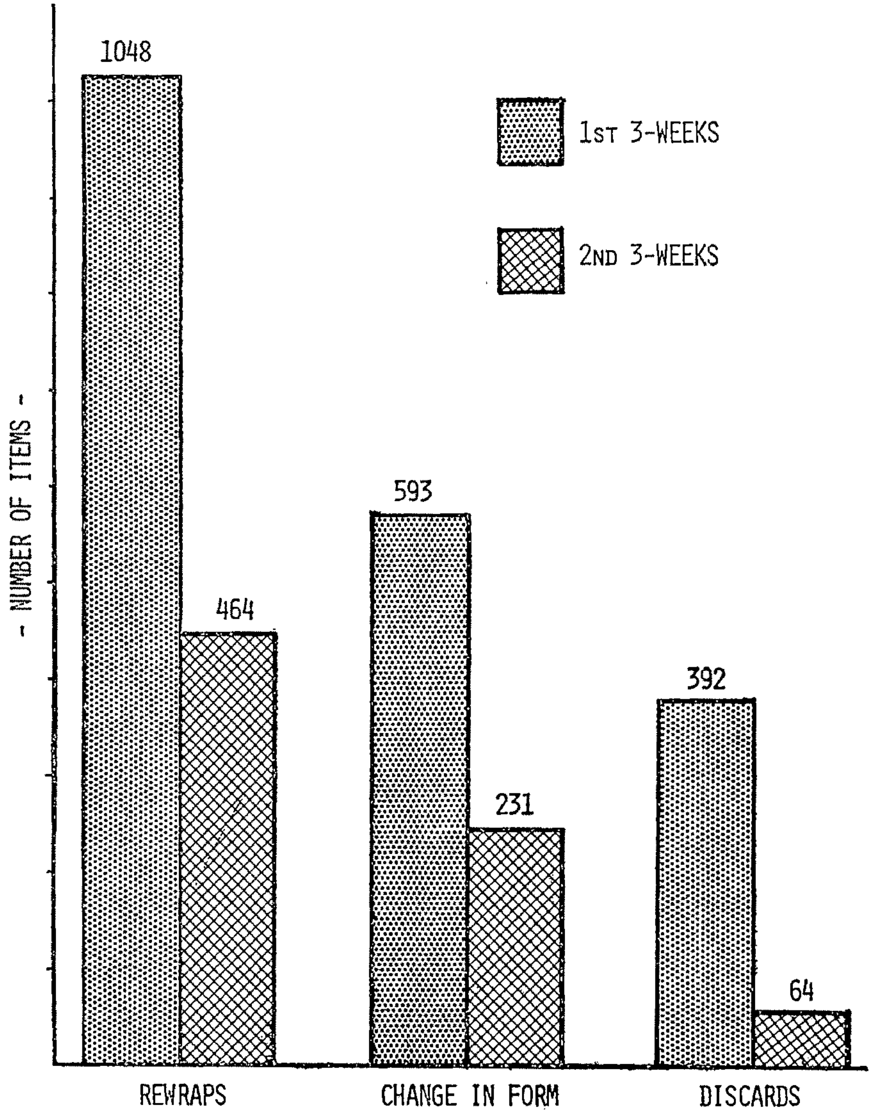

Figure 1. Comparison in number of items handled, by various categories, for two time periods

the product involved 362 fewer packages during the second time period. Weekly savings in product value for reprocessed items averaged $71, with a reduction of 61 percent in the number of packages handled.

Total gross savings for the second three-week period of operation was $757.

Net savings resulting from the sanitation-management program in the test store, after deducting costs, was estimated at approximately $169 weekly or $8,808 annually.

Incentive Program

Results of the study were reported to top management, who decided to implement a sanitation program in all it stores. Several meetings were conducted by Extension personnel and store supervisors to acquaint other employees with the program. To create employee interest in the program, the company sponsored a contest. Prizes and awards were based on criteria established to measure improved performance relating to how well each store put the sanitation program into practice. Also considered were resulting financial gains and overall improvements compared with past standards of performance. Winners of the contest were selected quarterly. The incentive program continued for one year to provide continuity and follow-through.

Conclusions

In the opinion of the author, similar reduction in losses and increased dollar returns as reported could be realized by most retailers who are willing to follow good sanitation practices, motivate employees, and manage their meat departments with the goal of maximizing profits.

Results obtained from this pilot study provide for a basic educational program in depth which can be extended to promote better meat handling practices among other food retailers.

It is hoped that, information on the case study approach will aid other marketing specialists to improve their teaching effectiveness and possibly stimulate other ideas for improved methods of implementing research findings.

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THE ORGANIZATION OF AGRICULTURE

CHAIRMAN: MARSHALL HARRIS, UNIVERSITY OF IOWA AND USDA

Variants and Invariants in Comparative Agricultural Systems

FOLKE DOVRING

THE theme suggests a standpoint. Does agriculture have more invariants than other industries and other parts of society? The implicit standpoint is that it has. Its friends and admirers point to it as a stabilizing force in an unruly society, a bedrock of patriotism and good mores. Its detractors underline its seeming inertia, its sluggish reaction to innovations, its tendency to cling to outmoded ways of production and societal organization.

The value judgments rest on value systems, evidently; but before passing judgment, one way or the other, we should know the facts. Is the predominantly "invariant" aspect of agriculture a fact—or is it an optical illusion, and, if so, for what reasons? A question as generic as this one cannot be answered in the same generic form. It is necessary to examine some of the historical and contemporary evidence. The purpose is not merely an intellectual exercise. More than that, we need orientation for our thinking about the future—the future of the already high-income societies, which are about to enter developments without precedent, hence without direct empirical basis for expectations; and the future of the low-income societies, which may not merely repeat the past history of the advanced ones but may also leapfrog stages and otherwise telescope the known patterns.

The seeming inertia of "traditional" agriculture rests, in any event, on hindsight based on modern experience—over the last hundred years, hardly more. In the long perspective of the millennia, agriculture has been one of the most dynamic forces of human change; from the neolithic age to the Renaissance, most technical innovations of any consequence were agricultural innovations. Modern agriculture in advanced countries, again, is of course anything but static in its technology, productivity, and economic relationships; but many are impatient or uneasy about its institutional framework.

The stability dictum rests in fact mainly on observations about the institutional systems. At the center of agriculture's institutions stands the concept of tenure. It can be maintained as the centerpiece of a coherent analysis by regarding it, above all, as a system of decision making no less than as a device for distribution.

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A Concept of Tenure

Tenure to what? Not just land, that is too narrow; ultimately we might talk about tenure to all the rights which the cultivator holds both as a producer and as a community member. The classical idea of fee simple or freehold was generated in the vacuum of abstract thought in the ages of enlightenment and classical liberalism, encountering the physical vacuum of the North American frontier.[1] The Middle Ages originally did not know tenure to land in any absolute sense; they knew tenure to specific rights, territorial or otherwise. The modern concept of "bundle of rights" again admits that separation of the sticks is normal, so much so that some sticks always (at least potentially) belong to the public powers.

Tenure in the conventional sense means one or more of three things: an opportunity to manage resources (on own account, in some sense), or an opportunity to perform real estate operations, or the right to receive rent. The first two regularly imply some degree of control (if sometimes only indirectly or negatively) of others; the rent receiving function does not necessarily extend beyond its own narrow scope.

The first category is the most important one in the study of comparative systems, and here we may expand the concept in the way indicated. Under resource management, we may discern several levels of decision making:

(1) Operational tenure, or the right to plan and execute day-to-day operations in the running of a farm;

(2) Production planning tenure, or the right to decide what to produce, when, where, how, and with what result, as far as that is within his power;

(3) Market planning tenure, that is, the right to decide or at least influence the terms under which firms may actually operate in the community or industry:

(4) Political tenure—participation in setting the ground rules under which economic decisions can be taken at the various levels.

The first two categories relate mainly to tenure as conventionally defined; the last two encompass the whole area of vertical integration with all its consequences for the actual meaning of the conventional tenure concepts.

The definitions of operational and production planning tenure shade over into the long question of "size of farm," which will be treated in the next paper. Part of the problem lies in defining: Size of what? Plantation or cropper unit? Internalities or externalities? Are work crews solely the "extended arms" of the central operator, or are they to some extent (what extent?) responsible, partly independent agents?

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[1] Cf. [13].

Systems of control have their paradoxes. One of them is that the more narrowly control is conceived, the less efficient it sometimes becomes. For instance, the centralized Soviet system of State and collective farms leads to so much cheating at all levels that the central authorities in reality do not know what goes on in the country's agriculture. In Poland, by contrast, the operational decentralization of the small peasant farm system leaves agriculture much more open to inspection, hence more directly accessible to the kinds of control that really matter to planners at the national level.

Cultivator Control and Landlord Control

Cultivator control has culminated at two different stages of historical development: in the tribal village and in the semi-modern peasantry leading over to the modern type of family business farms, the latter type gradually surfacing in various countries as economic development proceeds. In between these two stages there have been various degrees of landlord control or even administrative control. In either case, the control of the peasant household was more in evidence on the production planning than on the operational level.

Landlord control sometimes took the form of large "manor households," as in Merovingian France and Saxon England and on many Latin American haciendas. On the whole, landlords did surprisingly little with their power to control the peasants. Most estate systems have been peasant farming under large-scale ownership, even when part of the land was under the direct management of the landlord or his agent. Their inefficiency was discovered in 18th century continental western Europe, hence the rising tendency for peasant liberation as typified by the Danish rural reforms beginning in the 1780's. The enclosures in England really flew in the face of this experience, and the compensating feature of some British landlords modernizing agriculture mainly through leasehold contracts has been vastly over-publicized [1]. Propaganda resulting from this English experience probably contributed to the expansion of latifundia in southern Europe and Mexico in the nineteenth century by the "privatization" of village commons.

Until recently, somewhat effective landlord control usually persisted in some of the situations where landlords were directly engaged in organizing the sale of products to markets outside the horizon of individual cultivators—thus, on the tropical and subtropical plantations, the Junker estates, and some of the south European and Latin American latifundia. In most of the grain farming areas of Europe and Asia, operational control (and often production planning control too) was ceded to cultivators, either by one leasing device or another or by outright ownership.

Under conditions of very slow-moving technology, and especially when population pressure was high, landlords and administrative authorities have had very little need to tell the peasants what to produce or how. The composition of farm rents and taxes was usually all it required to get the merchandise the markets wanted. The poorer the peasants, the more tightly they had to adhere to the going production system. The Communists in Russia never understood this basic logic of peasant existence, yet it is implicitly applied on the private plots. The present Chinese regime, facing an even tighter scarcity situation than the USSR did in the 1920's, also appears to be giving its peasants some more leeway.

As the time-tested efficiency of peasant farming shades over into the explicitly tested efficiency of modern family farming, let us remember that these systems both got established with very little help. Even in North America, the disposal of the federal domain created enough large ownership units to lay the basis for large-scale management if that had been in the cards, economically speaking [9]. Modern-time price supports have of course not been particularly favorable to small producers; yet, if anything, the prevalence of family-scale units is increasing in America and Europe—mechanization reduces the hired labor force faster than farm numbers.

Modes of Tenure

A connection between modes of tenure and the economic constraints that they occasion is often rather clearly visible when comparing the maps of tenure with those of farm types or specialized production areas. In the United States, the census maps indicate a connection between tenancy and field crops for cash disposal, while livestock areas and tree crop areas favor operator ownership. The validity of this observation is not even weakened by the fact that in some cases operator ownership is a managerial device to maximize the quality of work (the poultry broilers) or simply a means of spreading the risk (the Florida citrus groves).

Similar connections can be traced on the tenure maps of many other countries, e.g., several of those in Europe. On the face of it, it might appear that tenancy prevails where it always has ever since the medieval domain crumbled, but this only means that the best cash crop areas have remained such throughout the centuries. The converse truth is seen in the more outspoken subsistence areas of Europe (Norway, the French central massive), where landlords willingly sold out, on the strength of the "peasant rent" principle.

The inference is that the relative instability of short-term tenancy proves tolerable where the planning horizon is short and fixed investments of secondary importance.

The advantage of farmer ownership in providing security of planning is relative, because the situation leads to a recurrent drain on the farm's re-

Market Integration

The integration of individual production into large markets does not follow a single line of development from the subsistence household to the sophistication of today's urban society. Primitive societies had a great deal of local integration. The isolation of subsistence farming has been greatly overrated; even on very low income levels, peasant farmers nearly always produce some merchandise for a market. The increasing atomism of peasant farming in early nineteenth century Europe, for instance, did not mean that markets were served less well than before. Before prices began to fall in the 1870's, atomistic producer competition was necessary to prevent the starvation of cities.

Only under competition from cheap overseas produce did European peasants (and British landlords) begin to suffer seriously from their competition with each other. In England, this set off a long period of stagnation in agriculture. On the Continent, it became the starting point for farm cooperation.

Cooperation, to be effective, requires two basic conditions: market pressure under uneven bargaining position and a high degree of distributive equity among the producers [6, 7, 5]. It has accordingly been most efficient in Scandinavia, the Low Countries, Switzerland, Ireland, and lately also Japan. During the inter-war period producer cooperation also gained much ground in Eastern Europe. In the Soviet Union in the mid-1920's, farmers' cooperatives were well organized and even maintained their own trade missions abroad [11].

Cooperation was less successful in England and in the Latin countries than in Europe and America. The much more uneven property and farm-size distribution in these countries made the large landowners capable (or so they thought) of handling their own supply and marketing problems. In England and several commonwealth countries, publicly sponsored marketing boards have been established to assume some of the functions of cooperatives elsewhere.

There is a conflict between cooperative self-help and State support. Cooperation has reached some of its highest development in Denmark and the Netherlands, both of which until recently gave their farmers no price supports at all. In the United States, where depressed conditions came to agriculture only much later than in Europe, a promising start for farmer cooperatives seems to have been in part slowed down by the price support and other protective policy measures beginning in the 1930's. The same explanation may hold for Germany.

Credit, Price Supports, and Related Issues

Literature on economic development is nearly unanimous in repeating that peasant agriculture needs more access to credit. In specific develop-commented upon many times. They lead to special advantages of closeness and continuity and are the obvious reasons for the prevalence of cultivators' operational control. The differences in modes of tenure and type of tenancy also derive most directly from these factors and the specific risks which they entail. They also lend a peculiar dimension to the marketing and generally integration problems because the high risks would only be compounded if institutions were more volatile.

Factor proportions and relative factor prices have acted as brakes above all in the transition from traditional to modern technology. Given the fixity of the demand functions for food, the normal share of agriculture at different levels of per capita national product can be charted with some degree of confidence [2]. In the face of a storehouse of technically viable innovations, rates of substitution have quite rationally delayed the full-scale adoption of many of these innovations, as they still do in the low-income countries and many of those on the middle-income scale as well. Because of the basic nature of the relationships just mentioned, premature modernization (e.g., motorization) is done at the price of a very costly agriculture—in social account, at least. This is true whether the changes are rammed through by political authorities (the USSR, etc.) or adopted piecemeal by landed aristocrats lacking a comprehensive view of the whole economy. Economists pleading the agrarian-industrialist case in a capital scarce situation do not have the same excuse.

Inertia is often more apparent than real. The older stages of agricultural development have had fewer options than appears to the modern eye. The principle of "multiple lock-in systems" means that many situations which look inert to us have some hidden rationale that must be overcome before the system can be broken up or seriously modified.[3]

Nonetheless, a system once put in place tends to become a vested interest for those who draw more than average advantage out of it, and these people often include some of the most powerful members of the community. Thus, institutions have a built-in tendency to perpetuate themselves beyond the time when their original rationale has become obsolete. Possibly this tendency is accentuated in agriculture because of the virtually perpetual nature of the basic resource and the consequent fixity of its legal protection. Farm and property size distributions do appear to continue more unchanged over time than would follow from the needs of society; hence the pressure for land reform at certain junctures in development.

For the present low-income countries, it appears reasonable to draw certain lessons from at least the recent history of the developed ones (both free and Communist). The strength of small-scale, family based and cultivator operated farms is not only generally recognized in the free world but also, if grudgingly, in Yugoslavia and Poland; experimentation with small, self-reliant field crews in the USSR is an implicit concession to the advantages of closeness and decentralization inherent in the system of direct cultivator control.

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[3] See, e.g., [10].

The application of experience from tenure systems is much less clear. It is difficult to argue that either owner farming or tenant farming is economically superior, from the viewpoint of society. The security of farm ownership hinges so much on other economic factors that the issue may have to be thought through afresh; the alternatives are either very long-term tenancy or some ownership construct similar to the Mexican *ejido*.

Also for low-income countries, the fostering of cooperation would seem to be one of the main roads toward farmer self-reliance and grassroots democracy. The outcome depends, for one thing, on the degree to which the peasants are prepared to receive and develop the idéa, and for another, on how essential it really is at the juncture when it is being launched. Ultimately the somewhat authoritarian character of centralized planning may get into conflict with producer cooperatives, precisely when the latter begin to be successful.

Toward the Optional Society

The lessons of the past are not as valid for the future of the high-income countries. The basic reason is in the widening range of options consequent upon rising productivity and per capita income. As W. A. Lewis has said so eloquently, the one aspect of development that renders it unequivocally desirable is the wider range of choice, hence the greater freedom, which it offers people [8].

Past periods, from the tribal village to "classical" or semi-modern peasantry, have had much fewer options. It is a misconception that archaic societies were more determined by cultural or social reasons and less constrained by economic ones. One does not have to swing full circle back to "dialectical materialism" to realize how many ostensibly non-economic institutions in traditional societies were economic ones in disguise.

At the level of affluence attained or attainable in a modern industrial society, the widening range of choices—for career alternatives and consumption alternatives–in the individual's life is quite obvious. A firm operating in a given societal setting may still find institutional constraints narrow and compelling; but for society at large, and for those who plan its future, wider choices are opening up. The higher the level of productivity, the less likely that it will hinge upon a precise set of institutions being maintained and established. There may still be choices that are unsuitable or clearly harmful; the giant farms of the USSR have still to show a profit. But among the classical alternatives (and some new ones, to be tested), the choice can increasingly be made on grounds other than that of economic necessity. Contrary to what Marxian dialectic assumes, the future becomes less and less "inexorable."

The point can easily be made in the case of American agriculture, for instance. Its share in the national product is already quite small and will, toward the end of the century, be so much smaller that widely differing alternatives of organization and institutional setup will not be noticeable to consumers. With a value product of, say, about one percent of the national product, agriculture may be a "ward of the state" or a "syndicate," and neither option has to be cumbersome. Whether farms are owned by their operators or by private landlords or by land trusts may be a source of convenience or inconvenience to operators, but society at large will not have to make the choice for them. Whether there are family farms or "factories in the fields" will affect productivity too little for society to object to the choices which are the farmers' own.

Precisely because the choices no longer hinge on compelling economic reasons, there is an increasing risk that they may be made for apparent ones. For instance, those who go on advocating "factories in the fields" might carry the day not because they are right but because they are believed. The leeway for propaganda is in fact widening with the options [4, pp. 359 ff]. The task of the economist is no less critical or beneficial because he sometimes can show that options are close to being equal economically. It should be no small triumph for "the dismal science" to be able to yield some of the stage to concerns which are closer to men's hearts than to their pocketbooks.

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Economies and Diseconomies of Large-Scale Agriculture*

Philip M. Raup

THE American literature on economies and diseconomies of large-scale firms in agriculture is a curious mixture of riches and poverty. There are numerous empirical studies of size economies in agriculture, supplemented in the past decade by a growing volume of synthesized data, using simulation models and engineering-economic approaches [4]. But there are virtually no studies that explore in breadth and detail the problems that would arise if we had truly large-scale firms. The deficiency is easily explained though less easily excused. With a handful of exceptions, there are no truly large-scale firms in American agriculture. The few that exist are sensitive to investigation or study and remain generally inaccessible to economists and researchers if not always to *Fortune* reporters [3, 6].

There are no valid data on input-output relations, management problems, or marketing structures to use in synthesizing a 100,000-acre corn and oil-seed farm for Iowa, a 5,000-cow dairy farm under Minnesota conditions, or a 50,000-acre irrigated cotton farm in the Imperial Valley of California. Yet producing units (it is misleading to say farms) of these sizes and types exist in the Soviet Union India, in the Sudan, and elsewhere. It is not madness to suggest that they could develop in the United States, and some Florida, Texas, and California farms seem well on the way. The intent of this paper is to speculate (it cannot be more than that) on some of the probable consequences if they should.

A Brief Look at Available Studies

In summarizing studies of crop-producing farms (seven types of crop farms, fourteen different locations or situations, in five different states), Madden concluded, "In most of these studies, all of the economies of size could be obtained by modern and fully mechanized 1-man or 2-man farms" [4, p. 54]. Larger farms might increase total profits but would not result in lower average costs. Within the range of farm types studied, efficiency in resource use was thus largely irrelevant as an argument for increasing farm size above a two-man scale of operation.

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The acre size involved covered a wide range.[1] In California cling peach production, lowest average costs were achieved by orchards of 90 to 110 acres, if mechanized. In market vegetable crops, farms of 640 acres were almost as efficient as farms up to 2,400 acres and above, if use could be made of custom work for field operations.

In other California field crops, lowest average costs were attained by farms in the 600 to 800 acre range, producing some combination of sugar beets, tomatoes, milo, barley, alfalfa, and safflower. Average costs began to rise slightly for farms of this type above 1,400 acres in size, and (in another location) for farms above 3,000 acres in size, when cotton was included as one of the crop alternatives. For irrigated farms specializing in cotton, the most efficient California farms required four men and 700 to 1,400 acres (depending on soil type). In contrast, Texas irrigated cotton farms achieved lowest average costs with one-man operation on 440 acres. For wheat in Oregon, the one-man unit with 1,600 acres was also as efficient as larger farms.

Van Arsdall and Elder in Illinois used a simulation technique and linear programming to explore economies of size for cash grain and hog-producing farms over a size range requiring one to six men, with various combinations of four-, six-, and eight-row equipment [10]. Total acres ranged from 574 to 3,937 in the cash grain area and 355 to 2,104 in the hog area. Gross income ranged from $54,000 to $438,000.

In cash grain production (corn and soybeans), the efficiency reached by an optimally organized two-man farm, using eight-row equipment on 1,641 acres, was as great as that achieved by larger farms of up to 4,000 acres. In hog production, lowest average cost was achieved by a two-man farm using six-row equipment on 716 acres. Farms of up to 2,000 acres requiring a capital investment of almost one million dollars were included in the model.

In both cash grain and hog production, the efficiency achieved by one-man farms using eight-row equipment was almost as great as that computed for two-man farms, leading Van Arsdall and Elder to conclude that ". . . any size of farm considered in this study can compete effectively with the optimal two- or three-man units" [10, p. 53].

Although research methods and procedures differ, above a two-man scale of operation the studies show no significant economies or diseconomies of size throughout the size ranges studied. They leave us with no guidance to the central question asked in this paper: What are the economies and diseconomies of really large-scale farms in American agriculture? The question cannot be answered from available empirical data at the firm level.

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[1] The summary data that follow are from Madden [4].

What Existing Studies Do Not Tell Us

In all of these studies the focus has been on efficiency in resource use and on profit. It is remarkable that none of them has considered the after-tax position of owners and operators, thus ignoring the question of income tax policy as it may effect farm management decisions. For truly large-scale farms the after-tax position is crucial to the analysis.

Another serious defect of studies of economies of size is their static nature. With few exceptions, time is not a variable, in the sense that the growth pattern of the firm over time is excluded. Studies of firm growth are currently fashionable, and good recent reports are available [1, 8, 11]. Although a beginning has been made, key questions remain unanswered. What sizes and types of firms are most likely to survive a variety of simulated shocks or crises? In what size or structure of firm is the capacity and incentive for internal saving and investment maximized? How are the benefits of growth distributed among labor, capital, management, and entrepreneurship?

Most existing studies provide little information about the capacity of firms of different size to adjust to rising land values. Van Arsdall and Elder did explore this question, with some surprising results [10, pp. 39–41]. The study was programmed with land values at anticipated 1969 levels of $491 per acre in the cash grain area (East Central Illinois) and $332 per acre in the hog area (Northwestern Illinois). As a part of the simulation study, land values were permitted to vary from $491 to $1,353 per acre in the cash grain region and from $332 to $848 per acre in the hog area. At simulated land prices above about $850 in the cash grain area, grain crops were forced out of the program, and livestock (hogs) took over, based on purchased feeds. In 1969, land prices are in the $800 per acre range in East Central Illinois, yet corn and soybean production continues. We can only speculate on the compensatory adjustments taking place within firms.

Few of the studies surveyed provided for "growth" in management skills over time. Most of the studies, in fact, regarded management as a fixed cost or "fixed residual" over the size ranges studied.[2] As farm size increases, management becomes a critical cost item. Management skills must be learned, and producing a superior manager is expensive. To discuss the efficiency of farms of alternative sizes without allowing for the differential costs of producing the managers, plus costs of management error, feedback and growth in skill, is to ignore one of the most important aspects of transition in size of farm.

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[2] An exception is the study by Moore [5]. Labor supervision was charged in at the flat rate of $720 per man for farms ranging from one- to eight-man in size. The Ph.D. thesis by Thomas [8] is also an exception, in that specific allowance was made for increases in efficiency and output over time, due to improvement in managerial skill.

A potential advantage of large firms is greater capacity and flexibility in the purchase of management services. A scale large enough to justify employment of a resident nutritionist, entomologist, veterinarian, accountant, or tax consultant may be a critical measure of optimum size in some types of production. These services can also be retained under contract, but small farms typically do not have this capacity. Existing studies of size economies rarely include any discussion of the variable costs and returns for this aspect of the management input. Neither do they explore the possibilities that this source of potential economies of size might be made available to family-type farms through cooperatives or other forms of joint or communal enterprise. In theory, management services of this type should be among the most divisible of inputs. The farm operator ought to be able to contract for an hour, a day, or a week of these services. In a few places this is possible, but in practice they tend to be very lumpy inputs, available principally to the larger farms.

Big farms also achieve economies of size in bulk purchasing of fertilizers, chemicals, machinery, and other conventional inputs. On very big farms the cost of these inputs may be significantly lower than on one- or two-man farms, yet most studies have used constant prices for inputs in testing for economies of size. In this sense, available studies may understate the cost-reducing advantages of large farms.

Possible Diseconomies of Large Size

When firms grow very large, new problems emerge with regard to level of operation. In theory, a firm will vary output and factor proportions as prices change. One of the handicaps of the family firm is that it is often unable to behave in this manner, especially in the short run. Factors are committed to the production process and have a short-run marginal cost of zero. The family farm cannot fire its labor force and often has only two alternatives: operate at capacity or quit. Large, specialized firms in near-monopoly positions and faced with sloping demand curves may also in practice have only two choices: close the plant or operate it at capacity. Thompson and Proctor found this to be the case in a simulation study of a non-farm monopoly for which the product's demand was responsive to advertising [9].

The output responsiveness of large-scale firms to price change may thus be erratic, leading to large discontinuities in supply and in local employment. The response of organized labor in industry in similar situations has been to insist on stability-of-employment contracts. This is almost certain to occur in agriculture if large-scale firms develop. If fixed costs are a large part of total costs, and if labor contracts prevent layoffs, the net effect is to hold the firm at capacity operation long beyond the point at which marginal cost pricing would dictate a reduction in output. The large-scale firm in this respect may be comparable to the family farm in that its realistic options are to work at full capacity or close plants.

A major difference lies in the probability that the large firm would elect to increase its advertising budget rather than close plants. In the past, agricultural products at the farm level have been relatively undifferentiated. If production is controlled by a few large firms, this is almost certain to change. Where large firms are now important in the production of certain products (some fruits, nuts, and vegetable crops), we can already see the development of large-scale expenditures on advertising designed to create the illusion of differentiation. If this occurs, non-functional advertising will be an added measure of the diseconomies of large scale.

Another major difference lies in the fact that the quitting process for family firms is made up of many small withdrawals spread over time, allowing gradual adjustment in the communities and the industries involved. If a large plant is closed, it is a traumatic experience for the community. The reaction involves protective measures by the labor force and the community that become a major restraint on management decision making.

Large farms in the 50,000- to 100,000-acre class would also face problems with costs that are external to the small firm but internal to the large firm, including health, welfare, recreation, and a host of other responsibilities. The best illustration is provided by the experience of collective and state farms in Eastern Europe and the U.S.S.R. A major part of the farm manager's problems involves education, health, welfare, and maintenance of the local infrastructure. For example, in one large collective farm in the U.S.S.R. the account records revealed that farm road construction and maintenance costs in 1967 were over 200,000 rubles, equivalent to 21 percent of farm profits.[8]

The example reminds us that there are economies and diseconomies of size that can be measured only in terms of political or social welfare. Big firms in dispersed locations tend to dominate political processes. They either *are* local government, or control local government. There may be size economies in the provision of public services in a company town, but the price is often a stunted local political life. This emphasizes the fact that economies of size of big firms are often measurable, while diseconomies are typically intangible. It is not just magnitudes that differ; it is measuring scales.

This is nowhere better demonstrated than in problems of pollution control and environmental protection. The seriousness of these problems increases with size of firm. Manure on most family size farms is an asset; in very large feedlots, it is a liability. To date large firms in agriculture have often succeeded in evading responsibility for their contribution to pollution problems. This cannot continue. A major cost item for large firms in agriculture in the future will be for environmental protection measures that have been avoided to date or that are largely unnecessary when production is diffused over the landscape.[4]

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[8] Interview with Director, Kolkhoz "Kirov," Krasnodar Krai, U.S.S.R., August 30, 1968.

The Potentials of Market Power

We have almost no data that show the existence of economies of size in a technical or production economics sense for farm sizes above the two- to four-man range. There are data that suggest that, above this size, potentials for size economies lie largely outside the firm. The tentative conclusion is that, if big firms emerge in American agriculture, it will be due to market power, in both factor and product markets, and not to production efficiency as conventionally measured.

The potentials for exercise of market power lie in three major areas: power to control supply, power to alter demand, and power to attract capital. Within the limited scope of this paper it is possible only to outline the major issues associated with size economies achieved in these ways.

Private firms or groups of firms large enough to control agricultural production would no longer be private. Control on that scale can be enforced only by a take-over of some of the powers of government. If this occurs, it makes a mockery of any attempt to measure economies of size in a conventional sense. The price signals in the market place would be falsified, representing not true costs or marginal value products but the rewards of an arbitrary reallocation of rights. Agricultural supply control in a democracy can be only a political decision, to be resolved by political processes. The production efficiency of various sizes of farm firms should be considered in making that decision, and for that the studies reviewed in this paper provide guidance. But the procedure cannot be reversed. Rights to control supply cannot first be acquired by private firms or groups, followed by attempts to measure economies of firm size. That answer is determined by the allocation of the right of control.

The power to alter demand is typically represented by advertising. If new and better products can be introduced to a wider market, advertising can play a valuable economic role. Given the low elasticity of demand for total food in the United States, it is difficult to see how a structure of farm firms large enough to command advertising budgets on the scale needed to influence demand could serve any economic purpose. We have little evidence of production economies to be achieved through larger firms.

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[4] Environmental protection will be an item of increasing cost for agriculture in the future, whether or not production is concentrated in large firms. The magnitude of the cost item, however, will almost certainly be greater for large farm firms than the sum of the costs for small dispersed firms. This seems to be a clear case of diseconomies of size and concentration.

Economies of size do exist in processing and distribution, but it is not clear that these firms need to be integrated with production at the farm level. A large retailer may desire to obtain his supply from a large processor at specified qualities and known prices. The processor, in turn, may find it rewarding to control a part of his supply as a bargaining device in negotiating with farm producing firms. But the history of processor-producer integration is not a unilateral record of a take-over of control of farm production by processing firms.

This brings us to the question of power to control capital, which Shaffer has rightly stressed as one of the most important factors in determining the control of farming [7, p. 256]. Much of the capital in American agriculture is held in use by a combination of inertia, lack of information, and the difficulty of making occupational change. Over time, this capital may be replaced by other capital, attracted by rising land values and by institutional defects that result in favored treatment for certain classes of investors. The method by which we tax capital gains is an example. The increase in rural land values in the United States over 35 years has generated an expectation of continued increases. Inflation has reenforced the interest in land as an inflation hedge. This attracts capital from individuals less interested in current income than in capital preservation, or appreciation.

The owner or investor who can afford to forgo annual income in favor of capital gain can accept low annual rates of return while receiving competitive rates of return over time. If the nominal owner is heavily mortgaged, his return through capital gain may be especially high when computed on the base of his actual equity. High leverage and capital gains on the scale experienced over the past decade can convert a nominal rate of return on total investment of one or two percent into an effective rate of return on equity of eight to ten percent, or higher [2].

It is not only wealthy individuals who benefit in this way. Much of the cost of supplying land capital to American agriculture is apparently being carried by those who have left the farm but are willing to leave the operation of their share of the family estate in the hands of a farming relative or neighbor. Family sentiment, fear of inflation, hope of capital gains, a desire to hedge the uncertainties of non-farm jobs, or psychic rewards as landowners account for the commitment of a significant portion of the land capital now employed in farming. Just how large this is we do not know, and measuring its magnitude and mobility (or immobility) is a challenge to our research.

Capital is also being held in agriculture by government policies that affect the size of farms. Economists perpetuate the myth that one dollar is like another dollar in calculating costs or prospective rates of return. This is obvious nonsense. A dollar of property tax costs is unlike a dollar spent on labor or fuel in that it is a priority cost. In a similar way, payments by the Federal government through the various farm support programs are priority returns. They provide certainty in a planning process plagued with uncertainty. They are quite literally a form of guaranteed annual income.

By reducing uncertainty in farming, government support payments are of greatest value to those facing the greatest risks. The principal beneficiaries are those large farms making a heavy use of credit. The importance of these benefits increases disproportionately with size of farm and reverses the effect of a progressive income tax. This has held capital in agriculture and exercised a major influence over the pattern of size of firms.

The Role of Social and Institutional Change

Will the economic and social forces that supplied capital to American agriculture in the past be adequate for the future? Are we right to maintain income tax and farm support policies that are in effect a progressive subsidy to certain classes of investors? Is this distorting our evaluation of economies of size of firm in agriculture? It is a part of our current communal wisdom to regard the answers to these questions as dependent on technological developments. The more relevant conclusion is to recognize that social variables will be controlling.

Given the dependence of agriculture on weather, the structure of the family has been the major variable conditioning the size of farms in American agriculture. The farm in the past gave each family member something to do that was visibly productive. Each person contributed to the total welfare in a manner that could be understood and appreciated. Participation was a reality, not a slogan. Common goals existed and were comprehended. In times of crisis, identification with the farm elicited a sacrifice that made it possible to maintain the farm intact. Many family farms have been two-, three-, or four-man farms at critical seasons or for specific tasks. Returns per man-, woman-, and child-hour have been low, but the economic resiliency of the farm and its capacity to absorb shocks have been great.

Social and cultural variables are changing this life style, not just farm technology. Consolidated schools, the eight-hour day, the five-day week, coffee breaks, paid vacations, and many other dimensions of our increased leisure in urban occupations have had a pervasive influence on the farm family. As in all other sectors of American life, the hierarchical structure of the farm family is also changing. The automobile has given the farm wife much greater freedom and mobility in relative terms than its comparable impact on urban women. Rural women have realistic opportunities to enter the non-family labor force. The opportunity costs of their farm and family labor can be given a meaningful value in monetary terms. It is these changes that give the family farm a new definition. It is the family that is changing, not just the farm.

The two-man farm in this context implies a two-family farm, a connotation that is not often made explicit. Especially when livestock are involved, a multi-family farm makes it realistic to budget for labor requirements that include short work days and weeks, alternate free week-ends, and vacations. It is instructive to note that farm policy in the Netherlands, in Sweden, and in other countries of Western Europe is increasingly focused on the two-family farm as a norm [12]. Economic pressure, social norms, and cultural patterns are propelling agriculture in developed countries in this direction.

This is the setting in which it seems most rewarding to interpret the recent growth of family farm corporations. The corporate structure can give the flexibility needed to accommodate two or more families with different family goals and capacities. The impersonal nature of the corporate structure compels answers to questions about shares in ownership, value of labor and capital contributions, shares in returns, procedures for ownership transfer, and liquidation. The state, in effect, steps in as a third party and compels family members to ask and answer questions they should be considering but often avoid.

In this sense the corporation, creature and creator of the vast firms of the industrial world, may offer one of the most realistic hopes for retention and revitalization of relatively small-scale firms in the agricultural world

The challenge to our agricultural policy is to find ways to assist in the establishment of new sets of property rights and new patterns of distributive shares, to better serve a system of larger family farms and family farm corporations. By changing our institutional structure to keep pace with technological advance, we may find that the advantages we now associate with large size in farming are not the exclusive privilege of large firms.

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Discussion: The Organization of Agriculture

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Professor Dovring has given us a kind of overview of tenure forms through time and across countries. From his discussion, I come away with two main thoughts. First, agriculture has tended to change when economic and technical conditions warranted the change. Technology may have been available to change production techniques substantially. Yet the changes came when factor-product price ratios were favorable for adoption of the new technology. Maybe my interpretation here is a product of my biases, but it is where I come out.

Second, Dovring seems to leave me with the idea that family farms are here to stay. At least, he points out that this form of organization has held up well when compared with alternative organizational forms. His conclusions here support those of Nikolitch [2], who certainly has gone a long way in dispelling some of the current notions that family farms are beginning to take their place with dinosaurs as relics of the past. Nikolitch doesn't suggest that family farms haven't changed drastically. They have. Yet they remain family farms in the sense of entrepreneurship and management. Some management functions formerly done on farms have moved off the farm, but who would deny that the managerial component remaining on the farm generally is more complex than ever.

Independently of Nikolitch, I had looked back at the proportions of family and hired workers among the farm labor force. I found that 75.1 percent of farm workers were family workers in 1910, and 74.4 percent

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were family workers in 1968. Also, there has been almost no change in this proportion over time. This aggregate figure glosses over too many things, but if we had had substantial shifts toward large-scale farms we should have expected a shift toward proportionately more hired labor. Professor Raup implies this also in his paper. Marshall Harris seems to take exception to these ideas in stating that "... the rights to use tenure forms and to organize production units in sizes desired by entrepreneurs seem to be leading toward large units unacceptable to advocates of family farming" [1, p. 527]. What this points out, I believe, is the extent of the confusion existing today about economies of size in agriculture and the place of the family farm in the future scheme of things.

I feel that Raup recognizes and points out quite well many of the deficiencies in our present knowledge of economies of size (and diseconomies as well) in agriculture. We would like to know how large firms can withstand extreme changes in profit, and the importance of the management input as a determining factor cannot be overemphasized. I will come back to this later. Also, I think Raup makes an important point in that social and cultural values are having their impact on farm size and farm organization. I agree that farm families (including wives) want the same amenities as nonfarm families, and this does influence farm organization. I guess it works the other way a little too, in that technology makes it easier for these amenities to be achieved.

There are points in Raup's paper (and I will concentrate on it) that concern me, however. There is a thread of reasoning running through his paper that implies that farmers have been forced to remain on farms, even though they would have been better off elsewhere. The evidence on this point is not clear to me, and I strongly suspect that the abilities of most of these small farmers were such that their best alternative was where they were, at least for some time.

Raup's analogy of the family farm and the large-scale farm both operating at full or at zero capacity bothers me on two counts. First, I guess I've never really bought that argument with respect to the family farm. Second, he argues that this would mean violent shifts in supply if large-scale farms were the rule. Yet, the conventional wisdom is that supply has been remarkably constant under our existing farm organization. I think I must be missing a link in the logic. In addition, I would expect large farms to have a large share of their costs relatively variable. What the exact shape of their marginal cost is and how it would affect production changes as prices change, I don't know.

I wish that Raup had not gone all the way from the family farm to a monopoly model in his discussion. True, monopoly could exist in specialized circumstances, but it is not a likelihood for agriculture in the near future, in my opinion. There are enough interesting problems connected with large-scale farming without bringing in the added problems of monopoly and advertising.

Labor management, as Raup notes, potentially is a serious problem of large-scale farming. It is a problem in the sense of supervision, in the sense of fitting a 40-hour week to an occupation not always adaptable to such constant hours, and in the sense of the likelihood of unionizing labor and the attendant difficulties. It would seem that the unionization of farm labor would be a substantial deterrent to the growth of large-scale farms, but more information on this point must be obtained.

Sometimes we forget that economies and diseconomies of size proceed apace as farms get bigger. I agree with Raup that the diseconomies are more difficult to measure, and I'm speaking here of diseconomies within the farm. If we are really to understand economies of size in agriculture and what they mean for future agricultural organization, we must find a way to measure these management effects. Also, we need more knowledge regarding the capabilities for growth in farmers' (or potential farmers') managerial abilities, as Raup points out.

Potential economies and diseconomies may be greatly different for different types of farms. I'm sure they must be. We need better studies that spell out these differences among farm types. I suspect, for example, that much of the land-clearing and drainage operations taking place in the Southeast could be accomplished only by rather large corporations. Yet, I believe there is a very real question whether, once cleared, these units can be more efficiently operated as one large unit or as smaller, family farms. Much must depend on management, and the differentials in managerial ability of farm operators are immense. Many have one-man or two-man limits to their managerial capabilities.

I don't know precisely where we are headed, as far as American agricultural organization is concerned. Surely, farms will be much bigger, more specialized, more mechanized, and will use more credit. Yet they may continue to be predominantly family farms—or they may not. It is quite important to get better research results relevant to this problem, a problem with substantial economic and political connotations. We need to be able to make more meaningful statements about the types of farms we can expect in the near future, as well as the potential effects of such changes on communities. One would hope that we can devise research to give us better insights into this question, and this may, in turn, bring about a more sensible evaluation of agricultural organization and its policy implications.

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Discussion: The Organization of Agriculture

DANA G. DALRYMPLE

Variants and Invariants in Comparative Agricultural Systems

Dovring's paper on first reading is, I fear, a bit puzzling. Although he has much to say of value on a wide range of issues, it is sometimes difficult to follow his train of thought or to determine what his overall point is. The reasons may be twofold: His writing style tends to be baroque, and there is a failure to add up the sometimes exceptional parts into a clear theme.

To the extent that this occurs, it is unfortunate, because with a second and third reading, many valuable nuggets concerning the organization of agriculture begin to surface. Dovring has an extraordinary knowledge of the economic history of agriculture and is well abreast of contemporary problems. His writings are seldom without factual or conceptual reward.

The returns from this particular paper, however, are more apt to be intellectual than applied in nature. This is particularly true for one who, like me, is involved in international agricultural development programs. Dovring's historical analysis tends to be based heavily on Europe and the United States and is perhaps more relevant to those nations than to some of the current problems of the less developed countries.

Let me now turn to some specific comments. I should like to note both points of agreement and disagreement, but time scarcely allows both; instead, I shall follow custom and briefly question a few points.

Cooperatives

Dovring states that there is a conflict between cooperative self-help and state price-support policies. He doesn't say why, but one might infer some philosophical incompatibility. This was not wholly the case in the United States. While in the 1920's government support was metered to agriculture through cooperatives, the critical problems of the 1930's called for a more direct approach. It was decided to emphasize price supports. The "conflict" then was for limited resources.[1]

Dovring also indicates that "the fostering of cooperation would seem to be one of the main roads towards farm self-reliance and grassroots democracy" in low-income countries. I would be less sanguine, based on experience to date.

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[1] I am indebted to Wayne Rasmussen of the Economic Research Service for this point.

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Socialized agriculture

Dovring seems to think that farmers' cooperatives were a contributing motive for the collectivization of agriculture in the Soviet Union. While there may have been some hope in the early 1920's that the growth or enlargement of cooperatives would lead to a communal agriculture, they were not a positive motive for collectivization. The decision to collectivize was made on quite different grounds.[2]

Dovring makes passing reference to the private plots in Soviet agriculture. I might add that from 1959 to 1965 these holdings occupied less than three percent of the arable land but accounted for about one-third of the total agricultural output. They play a particularly important role in labor-intensive crops such as fruits and vegetables [3].

Credit and subsidization

Dovring should differentiate between formal and informal credit systems. Formal credit is, I suspect, more likely to be in limited supply and used for production than is informal credit.[3] Similarly, I think it is necessary to differentiate between static and dynamic economies; when a striking new technology has been introduced in a dynamic economy, there is apt to be a greater need for credit than in a stagnant society.

Dovring states that it is "absurd for the poor countries to subsidize their agriculture." I don't think he intended to make this statement as restrictive as it sounds. Input and price-support subsidies may well be in order in the short run if they help to speed the adoption of a new technology and to get agriculture moving. As agriculture gains momentum, they may be lowered or withdrawn.

Optional society

The last two paragraphs of Dovring's paper are both provocative and puzzling. His point that the structure of American agriculture may matter little to society is an arresting one and possibly true in an overall economic sense, but it overlooks political realities. Rather than public support for "factories in the fields," the current tenor is quite in the opposite direction. In any case, the individual farmer can hardly afford to ignore economics in organizing his own business.

Many other points could be discussed. Suffice it to say that Dovring has offered much grist for further thought and argument.[4]

Economies and Diseconomies of Large-Scale Agriculture

Raup's essay provides a useful summary of recent economic studies relating to large-scale agriculture in the United States. It also offers some interesting hypotheses. The paper is, however, less international in scope than I had hoped. Since U.S. agriculture is not now my main field, I shall largely defer further comment to my fellow discussants.

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[2] For a brief outline of the reasons as well as further references, see [1, pp. 204–206].

[3] For a discussion of the role of informal credit in one less-developed nation, see [5].

[4] Those with a further interest in systems of resource organization may wish to consult Foster [2].

But as a one-time marketing specialist, I must admit that I felt uneasy with Raup's comments on advertising and market demand. Large firms would undoubtedly attempt to increase the demand for their product, but the course they would take would be determined by a number of factors (e.g., the type of crop, degree of processing, and share of market). Direct retail advertising of the firm's own brand is only one—and perhaps not the most likely—of several possible approaches.

Like Dovring, Raup seems to neglect the unfavorable press that large corporation farms have traditionally drawn in the United States. In the future, this could be a matter of no little importance. I need only remind you of the current debate over the limitation of government payments to farmers.[5] Senator Gaylord Nelson of Wisconsin, moreover, is currently leading an investigation of the effects of corporate ownership of large farms.[6] His present attitude could not be described as favorable.

But both Raup and Nelson recognize that the incorporation of a family farm does not necessarily change its fundamental character. As one who was brought up on such a farm, I thank them for the chance to come in from the cold.

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[5] For a cogent recent summary of the arguments in favor of limiting payments, see [6] as well as the section on policy-payment limitation in this issue.

[6] Specifically, Nelson is concerned with "the rapid movement of large conglomerate corporations and other nonfarm interests into agriculture." See [4] for detail.

The Organization of Agriculture: An Epilogue

Gene Wunderlich

PROFESSOR Dovring has compressed an immense vision of the past and present organization of agriculture into his brief paper. As I am in general accord with him, I shall simply extend one of his points best expressed in his own words:

> The lessons of the past are not as valid for the future of the high-income countries. The basic reason is the widening range of options consequent upon rising productivity and per capital income.

We might ask, then, why are we concerned with the organization of agriculture? Is concern with the form of agriculture based on an assumed relation to efficiency, distribution, growth, or other economic feature? Or do we have an interest in form as such? If form is important either as a means or an end, do we know enough to influence or re-form agriculture in the "right" direction?

For high-income countries, at least, I think that we have been concerned too much with production, too little with distribution, and that, in our view of growth, technology has played God too long.

Any reference to the productivity of American agriculture runs the risk of being trite. Perhaps it is best summarized by an analyst of urban affairs, Lyle Fitch, who said, ". . . the agricultural development policy in large part has been a smashing success—American agriculture is the productive miracle of the world."

In the next decade or so, according to Rex Daly, output per man-hour on farms will more than double. Although this projection of present trend in productivity suggests remarkable change, the potential change is far more dramatic. If all farms produced as do the farms in the present $40,000-plus sales class, the projected production for 1980 could be supplied by one-half million farms.

Future attention to the organization of agriculture from the standpoint of farm production, therefore, might be oriented more toward the improvement of product quality, the integration with market services, and the maintenance of production flexibility. Whatever the orientation, the urgency of production problems in relation to other issues in agricultural and rural development appears to be declining.

Decisions to influence the organization of form of agriculture may well depend more upon its effect on income distribution than upon production. As Professor Raup said, the important economies and diseconomies are those that are external to the firm.

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So long as ownership of resources is vested in the persons who make the decisions on use, the relation between organization and income distribution is relatively simple. Even problems of capital accumulation and transfer are individual problems. As organization becomes more complex, the problems of incentives, rewards, and equities become matters not merely of productive efficiency but of relative well-being among participants in firms, industries, and societies.

Many features of our present property system may be growing obsolete. Private property does not always reflect interdependencies among individuals in the use of resources. As Harold Demsetz has pointed out, externalities are created when property is too ponderous to associate the interests of some people in the actions of others. The relation of property ownership to community institutions may change as residence becomes separated from property. New and increased use of rural space by an affluent, mobile population may call for the development of property interests that permit wider sharing of access.

Economists might devote less attention to production problems in agriculture and more attention to distribution problems, but I suggest we take a different view of growth problems.

The criticisms of our indexes of progress and growth by Mancur Olson, J. K. Galbraith, A. A. Berle, Jr., and others, while perhaps valid in their own right, have tended to focus on the products of the growth process. Somewhat less concern has been shown over the technocratic ideology responsible for the form and volume of goods and services.

If we assume changes in technology come upon us as exogenous, uncontrolled influences, then decision making will be directed toward adapting to new transformation functions, resource supplies or locations, or comparative locations. If farms have excess machine capacity, they must be enlarged. If desalination is successful, new areas must be irrigated. Technology occurs and then changes must take place.

James Shaffer illustrated the resignation with which agricultural economists have accepted technology when he said, "Tens of millions of people are threatened with technological displacement with little prospect of rapid and effective integration."

The assumption of omnipotent technology may be as dangerous a "fundamentalism" as the rural and urban types we have criticized. If technology is, as John McDermott says, the "opiate of the educated public" and "invested with high hopes for the improvement of mankind," its negative spillover effects can be excused in the name of progress. An advanced technological society requires agencies of highly centralized and intensive social control and a socially disciplined population. Democratic institutions are challenged. The impacts of technology on the broiler industry, for example, seem to support the McDermott viewpoint.

The attitude taken toward the management, control, formation, and distribution of the effects of technology will depend, in part, on its intended role. If acts of technological development are regarded as acts of nature, policies will be directed toward response to them. If, on the other hand, technology is regarded as an instrument of policy, perhaps it can be designed to serve other somewhat more basic ends.

The notion of controlling technology so as to encourage economic activity in the direction of other goals suggests some interesting possiblities for transforming agriculture. If we are capable, in ten years, of producing our food requirements with less than one-fourth of our present number of farms, will we need zero farmers by 1990? Or by 2000? Could food costs be reduced to the nominal level of another public service? How then to utilize agricultural resources in open areas?

In the spirit of speculation, we might consider some opportunities for a transformed American agriculture. One set of such opportunities might focus on labor and employment, another on the uses of open territory in rural areas, and still another on the uses of agriculture for cultural development.

How shall we employ our citizens? The number of persons employed in agriculture is now only a trifle higher than the unemployed of the total civilian labor force. Obviously, commercial agriculture, which had been exporting labor, will not by itself begin importing unemployed persons. Under a different set of economic conditions, perhaps in part a function of policy changes, a portion of what is now agriculture could be used as an employer of last resort, a buffer between industrial requirements and excess available labor, a retirement or supplemental occupation, a labor-intensive provider of specialized or premium quality products, and a subsistence occupation for nonconformists.

The concept of agriculture as an "employment sink" suggests an economic use of agriculture somewhere between the industrial agriculture sector and the poverty sector.

How shall we use our open space? Increasing concern on the part of Federal, state, and local governments in the management and development of rural space is part of a growing public awareness of values associated with the natural environment. If agriculture is to become a custodian of open space, it must receive instructions and incentives to offset private economic pressure to behave otherwise. Agriculture can be a type of recreation, but the commercial value of recreation as agricultural enterprise is questionable. The value of agriculture for open space is widely diffused with many features of a public good. Policies related to conservation and natural ecological balance through agriculture probably can be implemented only by large-scale private organization or government.

Can there be an "agri-culture"? If there is drama in a biological process, if there is beauty in the color and form of living things, if man can still identify with the sources of his own being, then many of the elements of an art form exist in agriculture itself. If agriculture can evoke a literature, inspire music and drama, and model paintings, perhaps it can become an art itself as did weaving, architecture, and the culinary arts, once they had transcended their vulgar purposes.

Agriculture as an art form could be casual entertainment in the form of a hobby or opportunity to satisfy drives to develop a craft or skill. Agriculture as an art form could be serious, as in life museums, for example, or as a kind of mass landscape architecture to mold vast areas.

Impossible? Unrealistic? Dovring tells us that, historically, "agriculture has been one of the most dynamic forces of human change." Why stop now when we have more means at our disposal than ever before?

ECONOMICS OF RESOURCE USE FOR DEVELOPMENT

CHAIRMAN: MAURICE KELSO, UNIVERSITY OF ARIZONA

Resource Endowments and Technological Change in Agriculture: U.S. and Japanese Experiences in International Perspective*

YUJIRO HAYAMI

THE United States and Japan, despite enormous differences in resource endowments, have attained high rates of growth in agricultural output and productivity. The patterns of growth in productivity and resource use are as contrasting as their resource endowments. This study searches for the common thread in the U.S. and Japanese agricultural growth by appraising the historical experiences of the two countries within a cross-country perspective.

Growth Records in U.S. and Japanese Agriculture

The growth records of U.S. and Japanese agriculture for 1880–1960 are summarized in Table 1. During those eighty years, agricultural output increased at the annual compound rate of 1.5 percent in the United States and 1.6 percent in Japan; output per worker increased at 2.4 percent in the United States and 1.9 percent in Japan; total factor productivity increased at 0.7 percent in the United States and 1.0 percent in Japan.

A remarkable feature is that such overall growth rates of equal magnitudes were attained under extremely different endowments of land and labor. Arable land area per male worker was less than one hectare and increased by only 60 percent during the eighty years in Japan, while in the United States it increased more than four-fold from 10 hectares in 1880 to 46 hectares in 1960. In Japan the supply of land has been inelastic and the growth in labor productivity was primarily brought about by the increase in output per unit of land area. In the United States, at least until the 1930's, labor productivity growth was primarily the result of the increase in land area per worker.

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* Minnesota Agr. Exp. Sta. Sci. J. Ser. No. 6979. This paper is the condensed version of [3] and it draws heavily from two earlier papers [2, 4]. The author acknowledges the helpful comments of H. F. Breimyer, B. F. Johnston, S. V. Ciriacy-Wantrup, R. E. Evenson, M. M. Kelso, M. R. Langham, J. F. O'Connor, Kazushi Ohkawa, W. L. Peterson, V. W. Ruttan and J. H. Sanders. He wishes to thank the Rockefeller Foundation for financial support.

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Table 1. Changes in output, productivity, and factor-factor ratios in the United States and Japan, 1880-1960[a]

	1880	1900	1920	1940	1960	Annual compound rate of growth 1880–1960
						percent
United States						
Output index (1880 =100)[b]	100	155	180	232	340	1.5
Productivity index (1880 =100)						
Total productivity[c]	100	112	105	128	179	0.7
Output per male worker	100	125	141	217	680	2.4
Output per hectare of arable land	100	91	73	94	143	0.4
Factor-factor ratios						
Arable land area per male worker (hectares)	10	13	18	22	46	2.0
Power per male worker (horsepower)[d]	1.8	2.2	3.0	6.7	40.9	3.9
Fertilizer per hectare (kg. in $N+K_2O_5+P_2O$)	1.5	3.3	5.0	9.5	41.6	4.1
Japan						
Output index (1880 =100)[b]	100	149	232	264	358	1.6
Productivity index						
Total productivity[c]	100	142	195	208	229	1.0
Output per male worker	100	152	238	326	453	1.9
Output per hectare of arable land	100	135	184	205	280	1.3
Factor-factor ratios (1880 =100)						
Arable land area per male worker (hectares)	0.61	0.68	0.79	0.96	0.97	0.6
Power per male worker (horsepower)[d]	0.15	0.16	0.17	0.29	1.01	2.4
Fertilizer per hectare (kg. in $N+K_2O_5+P_2O$)	13	17	63	115	260	3.8

[a] Flow variables such as output and fertilizer are five year averages centering on years shown. Stock variables such as land and labor are measured in years shown. Data sources are explained in [3].

[b] Gross output net of seeds and feed.

[c] Output divided by total input.

[d] Sum of draft animal power and tractor power.

The ways inputs other than land and labor were used and technology developed are also contrasting. In the United States it was primarily the progress of large-scale mechanization that made it possible to increase the area operated per worker. In Japan it was primarily the progress of biochemical technology, represented by seed improvements with larger application of fertilizer, that induced agricultural growth under the severe constraint of land endowment. Although U.S. agriculture has experienced significant biochemical innovations since the 1930's and farm mechanization has progressed at an accelerating pace since the 1950's in Japan, the overall contrast is conspicuous at least for the period before 1940. Is there a common thread in such contrasting histories of agricultural growth?

Cross-Country Comparison and the Hypothesis

In Figure 1a, the partial productivity ratios, agricultural output per male farm worker and output per hectare of agricultural land, are plotted for 38 countries. The slope of the line connecting each country to the origin represents the land-labor ratio or area per worker for the country.

Three distinct productivity scatters or paths can be observed: (1) the path indicated by the group of countries in the new continents, represented by New Zealand, Australia, Canada, and the United States, where man-land ratios are particularly favorable; (2) the path indicated by countries in Asia, represented by Taiwan and Japan, where unfavorable man-land ratios prevail; and (3) the path indicated by countries in Europe, represented by the Netherlands and Belgium, in which the condition of original factor endowments is between the other two groups. Each path seems to represent the long-run process of agricultural growth for a given man-land ratio. The endowments of land and labor can be treated as largely exogenous to the agricultural sector.[1] Given the resource constraints, farmers try to increase output and income. In one case, it is land that limits the increase in output; in another, it is labor. In order to ease the limitation set either by land or by labor, farmers try to economize in the use of the limiting original factor or to substitute for it with man-made inputs, e.g., fertilizer for land and tractors for labor. The growth path suggested by the countries in the new continents seems to reflect the process of easing the limitation set by labor, and the one suggested by Asian countries to reflect the process of easing the limitation set by land.

In Figure 1b, the factor-factor ratios, fertilizer input ($N + P_2O_5 + K_2O$) per hectare of the agricultural land and tractor horsepower per male worker, are plotted. The former is used as an index of the level of input of the factors that substitute for land, and the latter is an index of the input of the factors that substitute for labor. It will be seen that the productivity ratios of the respective countries in Figure 1a correspond roughly to their positions of input mix in Figure 1b.

The relations observed in Figures 1a and 1b suggest the hypothesis that growth in agricultural productivity is essentially a process of adaptation of the agricultural sector to new opportunities created by the progress of inter-industry division of labor accompanying industrialization. The term industrialization, as used here, does not mean the expansion of manufacturing sector alone but rather the coordinated growth of manufacturing and service industries, including international trade and transport. If we measure the industrialization by the number of male workers in the non-agricultural sector relative to the total number of male workers, we find the countries located close to the efficiency frontier in Figure 1 are high in this ratio: 0.82 in New Zealand, 0.87 in Australia, 0.91 in the United States, 0.92 in Belgium, 0.88 in Netherlands, and 0.74 in Japan around 1960 when this comparison is made. In contrast, this ratio is very low in countries located nearby the origin: 0.41 in Mexico, 0.31 in Colombia, 0.47 in Syria, 0.39 in Turkey, and 0.31 in India and Pakistan.

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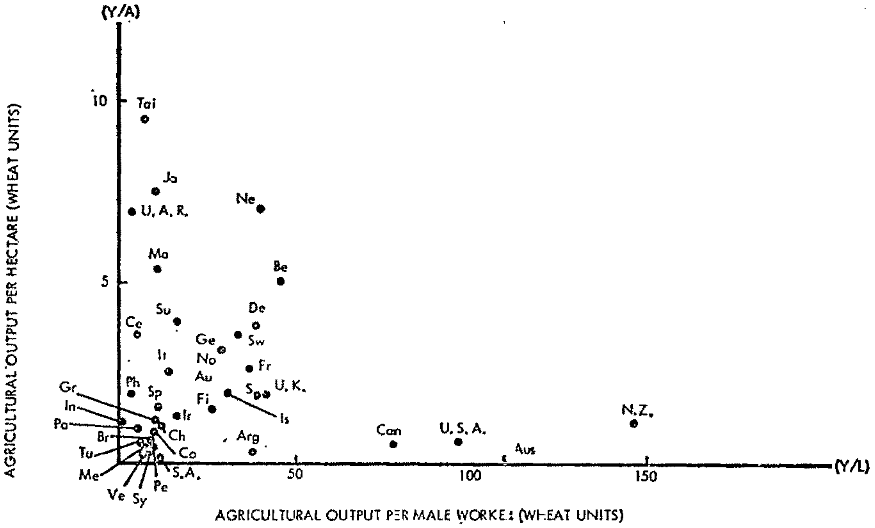
[1] This, of course, is not exactly true. Especially, labor may better be treated as a variable determined simultaneously through as inter-industry demand and supply system. Here we treat labor as approximately exogenous to agriculture in the sense that it is primarily the nonagriculture sector which determines its share of existing labor force and that the residual is employed in agriculture sector.

Industrialization affects agriculture in many ways. The expansion of the nonagricultural sector, requiring more food and materials, shifts the demand for farm products upwards, stimulating farmers to increase the use of inputs and to adopt new technology in order to meet the increased demand. More crucial are the changes in the supply conditions of agricultural inputs. With the progress of inter-industry division of labor accompanying industrialization, increasing returns, as conceived by Allyn Young [7], set in and the costs of such modern agricultural inputs as fertilizer, chemicals, and tractors are reduced. Agricultural growth can be attained through the adaptation of the agricultural sector to the lower prices of such modern inputs relative to land, labor, and product prices.

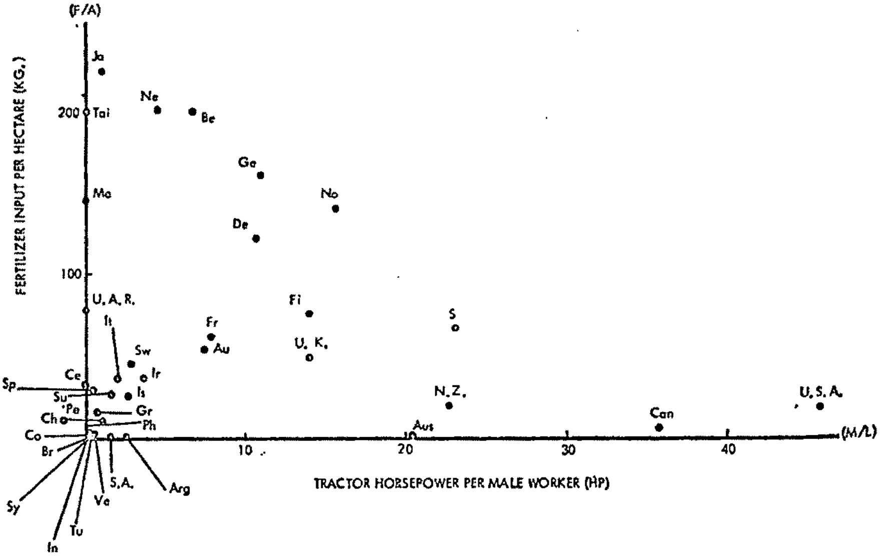
Figure 1a. Cross-country comparison of land and labor productivity ratios in agriculture



Such opportunities do not bring about productivity growth unless they are exploited adequately. A requisite for agricultural productivity growth is the capacity of the agriculture to adapt to a new set of factor and product prices. This adaptation involves not only the movement along a fixed production surface but also the creation of a new production surface that is optimum for the new set of prices.

For example, even if fertilizer prices decline relative to the prices of land and farm products, increased application of fertilizer is limited unless new crop varieties are selected which respond better to fertilizer.

Figure 1b. Cross-country comparison of fertilizer input $(N + P_2O_5 + K_2O)$ per hectare of agricultural area and tractor horsepower per male farm worker



Notes to Figures 1a and 1b: Flow variables, output, and fertilizer input are measured as 1957–62 averages. Stock variables, labor, land, and tractor horsepower are measured in years closest to 1960.

Wheat unit = equivalent to one ton of wheat; Agricultural output is aggregate of individual agricultural products using wheat relative prices as weights (one ton of wheat = 1).

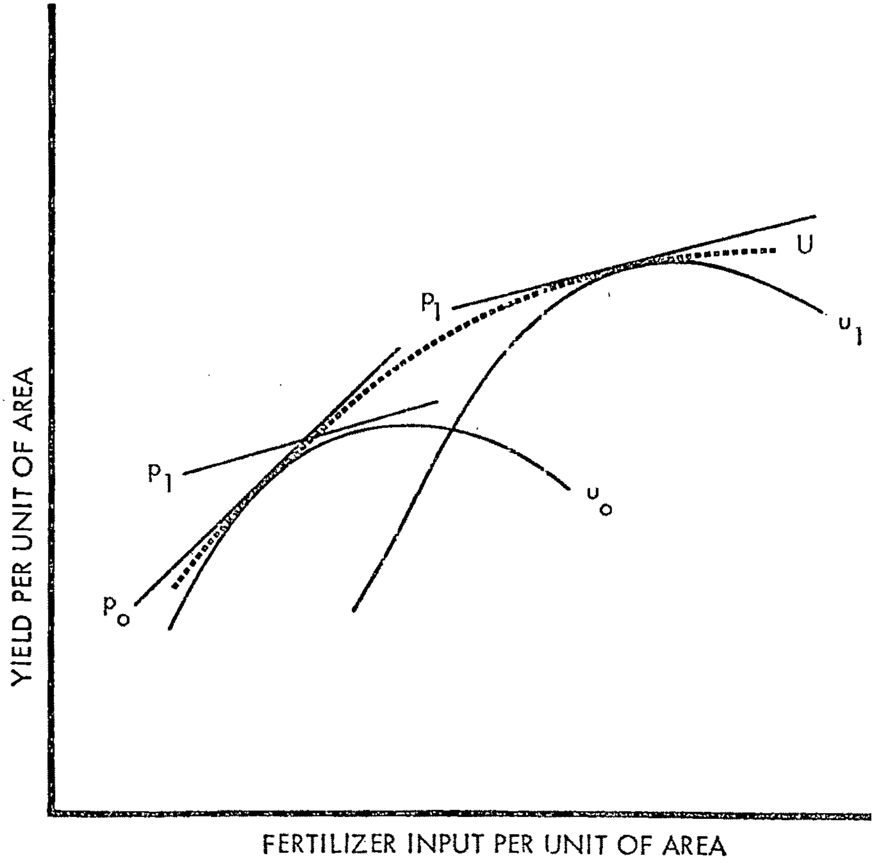
Source of data: [4].

Key to symbols:

Arg.–Argentina
Aus.–Australia
Au.–Austria
Be.–Belgium
Br.–Brazil
Can.–Canada
Ce.–Ceylon
Ch.–Chile
Co.–Columbia
De.–Denmark
Fi.–Finland
Fr.–France
Ge.–Germany (West)
Gr.–Greece
In.–India
Ir.–Ireland
Is.–Israel
It.–Italy
Ja.–Japan
Ma.–Mauritius
Me.–Mexico
Ne.–Netherland
N.Z.–New Zealand
No.–Norway
Pa.–Paraguay
Pe.–Peru
Ph.–Philippines
S.A.–South Africa
Sp.–Spain
Su.–Surinam
S.–Sweden
Sw.–Switzerland
Sy.–Syria
Tai.–Taiwan
Tu.–Turkey
U.A.R.–U.A.R.
U.K.–U.K.
U.S.A.–U.S.A.
Ve.–Venezuela

Traditional crop varieties in less developed countries have long survived under unfavorable environmental conditions with little fertilization. Consequently, they tend to have higher yields than improved varieties without fertilization but respond less to heavier fertilizer application. This relation may be drawn as u_0 and u_1 in Figure 2, which represent the fertilizer response curves of traditional and improved varieties, respectively. For farmers facing u_0, a decline in fertilizer price relative to product price (p_0 to p_1) would not create much increase in fertilizer application or in yield. The benefit of a decline in the fertilizer price can be fully exploited only when u_1 is made available to farmers through the selection of more responsive varieties.

Figure 2. Fertilizer response curves



Conceptually, it is possible to draw a curve such as U in Figure 2, which is the envelope of many such response curves, each representing a variety of different degrees of fertilizer responsiveness. The envelope may be called an "innovation frontier curve" or a "meta-production function." It is hypothesized that the adaptation of agriculture to new opportunities in the form of lower relative prices of modern inputs involves an adjustment to a new optimum along this meta-production function.[2]

The endowments of the original factors, land and labor, appear to have a significant influence upon the location of respective countries along the meta-production function. Where labor is the limiting factor—limiting in the sense that its supply is inelastic—the optimum for new opportunities in the form of lower prices of modern inputs is likely to be the point with the higher land-labor ratio. Movement to this new optimum would involve mechanical innovations embodied in the new forms of power and machinery. On the other hand, when land is the limiting factor, the new optimum is likely to be the point at which yield per hectare is higher for higher level of fertilizer input. Movement to this point would involve biochemical innovations.

It seems possible to explain the vast differences among countries in productivity and input mix in agriculture by the hypothesis of the adaptation of agriculture to the new economic opportunities created by development in the nonagricultural sector. It must be noted that this adaptation does not occur without cost. The development of a fertilizer responsive variety that is optimum for a new set of prices requires investment in research before it can actually be made available to farmers. Farmers seek new inputs and new techniques in order to move along the meta-production function in response to a new set of prices. The public research institutions and private farm supply firms perceive this demand of farmers and try to help them best exploit new opportunities. Unless this mechanism of dialectic interaction functions properly, productivity growth in agriculture is not ensured.

U.S. and Japanese Experiences in International Perspective

How do the United States and Japanese growth paths stand out in cross-country dimension? The time series paths of agricultural productivity growth in the United States and Japan are plotted in Figure 3, which presents enlargements of Figures 1a and 1b. The numbers in the parentheses indicate the percentage of male workers in nonagricultural occupations in the total number of male workers. The time-series path of the United States is nearly parallel with the line connecting Mexico, Argentina, Canada, and New Zealand, and the path of Japan is parallel with the line connecting India, the Philippines, Ceylon, and Mauritius.[3] The historical relationships between the level of industrialization and the level of agricultural productivity both in the United States and in Japan are quite similar to the cross-country relationship.

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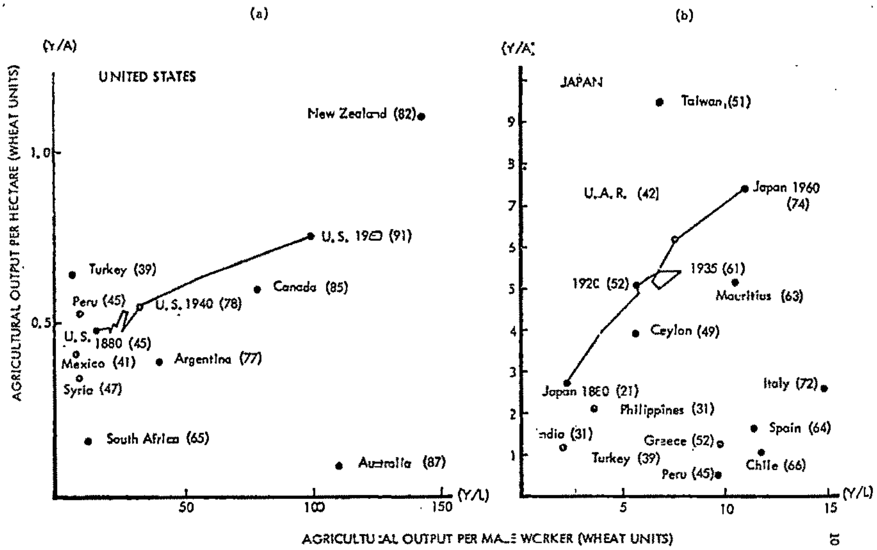
[2] Using a distributed lag model, Griliches explained the increase in fertilizer input solely by the relative decline in fertilizer price [1]. It could be identified that the demand schedule he estimated corresponds to this meta-production function. Unless biological innovations represented by hybrid corn occurred, fertilizer input would not have increased as much as it actually did.

[3] A line which connects India, U.A.R., and Taiwan seems to suggest the existence of another path of agricultural growth characterized by the growth in land productivity with the development of irrigation.

Considering the crudeness of data, this similarity is rather impressive. The parallel relationships between the growth path of the United States and the scatter of countries in the new continents and between the path of Japan and the scatter of Asian countries suggest that the direction of agricultural growth along the meta-production function is strongly constrained by the endowments of original factors. In Japan, land has been the limiting factor and the efforts of farmers, public institutions, and agricultural supply firms to exploit new opportunities have brought about significant biochemical innovations represented by seed improvements with larger application of fertilizer. In the United States, where labor has been more limiting, advances in mechanical technology have become the main feature of agricultural development.

Figure 3. Historical growth paths of U.S. and Japanese agriculture compared with cross-country relationship (enlargements of Figure 1a)



In the United States, the number of work animals per worker increased up to 1920, reflecting the progress of horse mechanization. Such major innovations as the introduction of the self-rake reaper as a substitute for the hand-rake reaper and the introduction of the binder as a substitute for the self-rake reaper required a larger number of horses per worker. After 1920 the number of horses per worker started to decline, but tractor horsepower per worker more than compensated for this decline. The use of the tractor was itself a major mechanical innovation in agriculture and the increase in tractor horsepower per worker represented a process of continuous mechanical innovations as it was accompanied by the improvements in transmission system, attachments, etc. The increase in power per worker accompanied dramatic decline in the price of machinery relative to the wage rate; it continuously declined from 100 in 1880 to 17 in 1960. In Japan, though the relative price of farm machinery declined, power per worker did not increase significantly, due to the strong constraint of the land-labor ratio.

In Japan, the fertilizer price relative to the price of arable land declined from 100 in 1880 to 5 in 1960. Corresponding to this rapid decline in fertilizer price, percentage in the area planted to improved varieties of rice in the total area planted in rice has increased rapidly from the beginning of the period concerned, accompanying the parallel rise in fertilizer input per hectare of arable land area (see Hayami and Yamada [5]). This clearly reflects the factor substitution along the isoquant of meta-production function. The fertilizer input per hectare increased also in the United States corresponding to the decline in the relative price of fertilizer. However, it was not until the 1930's that the U.S. level of fertilizer input per hectare reached the Japanese level of the 1880's. It is significant that the dramatic biological innovations represented by hybrid corn started at the same time. Before the 1930's, fertilizers were primarily used for cotton and tobacco, crops which are characterized by soil depletion. The depletion of natural fertility was also significant especially in the newly cultivated Great Plains. It seems likely that the level of supply of plant nutrients per unit of cropland, after deducting the depletion of natural fertility, would have remained roughly constant or even declined. This is consistent with the stagnation in land productivity before the 1930's.

As stressed previously, innovations in response to price changes in order to adjust along the meta-production function involve substantial cost. The U.S. efforts in agricultural research and extension are well known. In Japan the national efforts to develop agriculture began with the Meiji Restoration, which initiated the period of modern economic growth in Japan.[4] Beginning with the direct import of Western crops and machineries in the 1870's (which mostly turned out failures), Japan succeeded by the beginning of this century in building a rather unique system of technology called *Meiji Noho* (Meiji Agricultural Technology), which is essentially the reformulation of indigenous techniques practiced by veteran farmers on the basis of German agricultural chemistry and soil science. Farmers, especially those who belonged to the *Gono* class (landlords who cultivated part of the land they owned themselves) actively participated in the development of this technology. Most improved rice varieties available before the 1920's were the varieties selected by farmers themselves. Experiment stations made comparative yield tests and adaptive research in order to propagate the varieties selected by veteran farmers. Such techniques as the selection of rice seeds in salt water and the oblong-shaped nursery bed were selected from the farmers' practices through the tests of modern science. They were tailored by scientists and were propagated over the nation. Farm supply firms also perceived and tried to meet the demand of farmers. Long before the chemical fertilizer industry developed, the cost of plant nutrients in commercial fertilizers had declined. This was based on the efforts of fertilizer supply firms to exploit the opportunities created by the inter-industry division of labor accompanying industrialization. The costs of herring meals from Hokkaido and soybean cakes from Manchuria were greatly reduced because of improvements in transportation, storage, and marketing efficiencies.

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[4] See, e.g., Ogura [6].

Conclusion

The agricultural growth experiences of the United States and Japan in reference to cross-country observations were explained by the hypothesis of the adaptation of the agricultural sector to the opportunities arising from the progress of the interindustry division of labor accompanying industrialization. This adaptation involves innovations produced through a dialectic interaction of farmers, public institutions, and private farm supply firms to exploit the opportunities available. The common thread in the success of U.S. and Japanese agriculture may be identified as the proper functioning of such interaction mechanism. It must be stressed that, unless there exists a system under which this mechanism works properly, industrialization would not contribute much to agricultural growth. The efforts for industrialization and economic development that neglected the establishment of such system would eventually be hampered by a lagging agriculture sector. More research must be directed to the investigation of the causes of success and failure in establishng a proper system of such interaction in the course of agricultural growth and economic development.

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Natural Resources and Growth: Towards a Non-Marginal Political Economics*

A. ALLAN SCHMID

INVESTMENTS in natural resource development require a non-marginal analysis. To institute the policy changes indicated by this investment analysis also requires non-marginal changes. These are the main propositions of this paper, which is divided into a part that asks where to go and another that asks how to get there.

Land economics, as an applied branch of economics, has been marked by a concern for major changes in the use of large areas of land and water such as from rural to urban or from dry land to irrigated agriculture. It is distinguished in degree from farm management, which is concerned with changes in choice of crops and combinations of inputs. In the latter case, a partial equilibrium analysis is used to evaluate a proposed change that is small enough to produce no feedback on the many variables that are assumed constant. This is what is meant by the term marginal analysis.

Land economists have always been troubled by the inadequacy of the marginal calculus for the kinds of problems they were interested in. The changes were so large that many other variables changed. This led many investigators to search for a non-marginal economics. The search has not yet been entirely successful. Land economists have a close affinity with those specialists investigating the economics of education and technological change who are also searching for non-marginal concepts.

In marginal analysis, the problem of growth and development does not really arise explicitly. If a disequilibrium exists, it can be removed to the profit of entrepreneurs; and, as this is done the economy will grow as much as is possible. The Keynesian revolution upset this when it was understood that an equilibrium could exist at less than the productive capacity of the economy. This gave us some new handles on growth, but it concentrates on the obvious potential of unemployed labor and leaves unexplained how the quality of available inputs changes. Unemployed people or unused land is one thing, but the skill level of the labor force and the quality of the land are another matter. The untapped potential of these is less obvious. Still, historical study suggests that there are opportu-

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nities for man to change the resources base. However, its change has remained largely outside of economic theory and investments to that end have proceeded, in too many instances, by blind faith.

Investment is of course subject to analysis. But investment in quality and new kinds of inputs is a distinctly non-marginal phenomenon. A change in skill level or bringing water to new land produces feedback and ramifications difficult to contain in marginal analysis. Also, the returns to this type of investment are difficult for private enterpreneurs to capture. The concepts of externality and "public goods" have been explored elsewhere [14]. It is enough to note here the important role of governmental investment in changing the resource base, whether it be man or nature.

This paper will explore illustrations of natural resource investments where marginal analysis is of limited usefulness. It further inquires into what can be done to introduce non-marginal changes in policy and institutions. The examples will deal with water resources, but many of the same points could be made with regard to other resources.

Part I: Where to Go

Resource investments versus other expenditures

The first substantive issue I want to explore is comparing the returns to public investments in natural resources versus other kinds of expenditures. One line of inquiry that must be examined is what might be called the RFF school of thought. It is argued by such Resources For The Future, Inc. associated writers as Harold Barnett that resource scarcity and rising resource prices are unlikely because of technological change [2]. The implication is that neither conservation nor investment directly associated with resources is as important as investment in new technology. Yet the latter remains largely undefined, and it is not clear how this technological advance can be maintained. How much of the past productivity increases in agriculture, for example, came from irrigation, drainage, and flood control as opposed to things like hybrid seeds and smarter farmers? Some studies of national growth assume a constant input of land. Yet the acres used today are not of the same quality as those of 50 years ago. I suspect we have grossly underestimated the impact of flood protection, which has probably added more productive acres than irrigation. However, it is symptomatic of our lack of consideration of explicit tradeoffs among alternative investments which improve the quality of inputs that there is no systematic record of the acreage involved, let alone the amount of production involved.

I do not mean to suggest that I think there are further great opportunities in developing new lands. However, I would like to see the historical record cleared up before we advise other nations to forget about natural resources investment since they played such a minor role in U. S. agricultural growth. There is one other international aspect that deserves note in passing. What happens if the whole world population consumed natural resources at the U.S. rate? Would technology still keep up?

Charles Howe has inventoried the available studies of the marginal returns to irrigation water and compared these with the costs of major new development from inter-basin transfer [6]. He concludes that these are marginal investments. Vernon Ruttan also concludes that irrigation returns do not seem to cover costs [11, p. 49]. Yet one can agree with this and still note, as Ruttan does, that some areas remain where there are good projects. The problem seems to be that our Federal or state agencies cannot always separate the remaining good ones from the poor ones.

Studies of education and research have compared returns there to such things as irrigation projects. Zvi Griliches shows returns to hybrid corn of hundreds of percent and contrasts this to low benefit-cost ratios for Federal irrigation projects [5]. While I share the thrust of his conclusion, I have some reservations. The problem turns on the non-marginal impact of both kinds of investment. Hybrid corn has increased production enough to affect prices. Griliches counts the consumer surplus in the hybrid research returns. However, he makes comparison with individual project studies for irrigation where there is no effect on price. Yet, if one is to draw conclusions on program priorities, the irrigation projects would have to be considered all together and the consumer surplus calculated for them as well. Griliches also ignores change in the quality of land used for corn. Again drawing conclusions for other countries I hope it will be remembered that even with hybrid corn and educated farmers, crops are poor on eroded, dust bowl land. There are some real problems in calculating contributions to real income gain over time that remain unsolved.

Urban development

On the urban development side, the case for water supply development is mixed. Charles Howe, in investigating the relationship of regional growth and different measures of water availability, concluded that "the evidence of the 1950–1960 decade . . . demonstrates that water did not constitute a bottleneck to rapid economic growth in water deficit areas of this country, nor did its presence in large quantities in other regions guarantee rapid growth of these regions" [7]. Robert Young makes a similar argument from his studies in Arizona and concludes that "the evidence demonstrates that water has not been the limiting factor on growth in Arizona up to the present time" [20].

On the other hand, it is clear that there are some areas where water supply is a real problem. The state of California has embarked on a multimillion dollar project to bring more water to southern California. While they might have had the alternative of reallocating irrigation water, this opportunity does not exist for New York or Washington, D.C., which narrowly missed a severe curtailment in use in the summer of 1969, saved only by last minute rains. There appear to be opportunities to develop regional metropolitan water systems, which should be further investigated.

Water as a resource for waste disposal also seems in great demand. A proposed Philadelphia housing development was prohibited in 1969 because the quality of the Delaware River was threatened [3]. This has happened in numerous other cities and probably would affect more if pollution control agencies enforced their regulations. While I judge that returns are high in water quality investments, I also fear that a great deal of money will be wasted on some very marginal improvements. This country seems to have an extensive resource development bias. We seem to do more for isolated national parks than for metropolitan parks and water fronts. We may be about to see some tired old water projects given new benefits by claiming water quality improvements even though these are marginal and in areas of low priority for that purpose. For another example, water agencies tend to use the same value for a recreation day in a sparse area as for one in a densely populated area.

Prest and Turvey in their authoritative review article on benefit-cost analysis note that present methods are not useful for analyzing returns from widely different kinds of programs [10]. The reasons for this include some of the non-marginal problems already mentioned. In addition, it is related to the fact that many of the goods produced have no market prices and must be priced by governmental representatives. I believe that, increasingly, the high valued water use will be for direct consumption, such as is involved in recreation, rather than as a producer good. We can never make any sense out of these investments until the publicly generated prices for these goods are made clear. Legislators are loathe to do this and try to shift the problem of representing their constituents to agency technicians. They hope the technicians will give them a "scientific" price, which in turn can be used to convince consumers that the reported price is in fact what they are willing to pay. Consumers are just becoming sensitive to many environmental products and, as for any new product, demand is uncertain.

There is another kind of problem in comparing resource development investments that does not arise in farm management analysis. In any area where public action is prominent, the Government has two broad ways to affect resource use: the investment route and the direct controls route [13]. Controls including zoning and other modifications of property rights. These are sometimes complements and sometimes substitutes for public spending. The move toward a non-marginal analysis must accommodate these dimensions.

To conclude this section, it can noted that, although the analytics are weak, there appears to be a need for some rather large changes in agency functions and allocation of budgets and water use. These are all going to come harder than the decision to shift cropping patterns a bit from corn to soybeans in response to a marginal change in prices.

Investment complementarity

One of the potential productivity gains in an economy is to take full advantage of economies of scale. To do so requires that different industries that use each other's inputs develop together, so that the one's expansion is not hampered by high cost inputs from the other which doesn't expand to optimum size because of an inadequate volume of demand for its product. Various Federal agencies are searching for the key input to trigger development. The water agencies think it is water while other agencies plead for highways, hospitals, schools, or what have you. My hypothesis is that there is no one key, but that several of these along with private investment must be brought off together.

In many respects private industry has done better at organizing different activities simultaneously than government, which is avowed to have the advantage in such matters. A prime example is vertical integration in broiler production where feed milling, feeding, and broiler processing are closely linked by advance contracts. In most public resource investments, by contrast, the factor improvement is made, and it is hoped that other investment will follow based on the disequilibria created. However, these are frequently not large enough to get movement in severely depressed areas. Industry often helps confuse the issue by assuring project planners that they will come in if only new water, navigation, or flood-free land is provided. Since such assurances have no cost to industry, it is a convenient way to increase the number of available sites and perhaps beat down land prices a bit.

Each agency applying analysis to its own marginal project is not going to be good enough. The federal water agencies are now in the process of revising evaluation practices to reflect indirect development impacts [18]. The weak link in such evaluation is to be sure that the water investment actually will create new jobs for unemployed. After this is established, the multiplier effects are relatively easy to compute. The proposed new evaluation practices are largely silent on how to capture economies of scale necessary to get the first round of employment effects. I suspect this is due more to failure to solve the institutional problem of coordination than to the analytic problem of calculating the benefits of such coordination. Here, the institutional economics lags behind the production economics opportunities.

This is a field where foreign economic development experience and domestic experience can aid each other. In some respects the foreign literature, such as that of Hirschman and Chenery, is far ahead of that developed on U.S. regional problems.

Public water investment and land value appreciation

Whatever the accomplishments of flood control programs, and they are many, there is one blemish on the record that dramatizes the failure to take a non-marginal systems view of resource problems. In spite of spending over $7 billion since 1936 in public investment in flood control structures, the annual damage is greater than before [1]. This is because each investment was conceived individually and ignored subsequent development of the flood plain.

The current practice is to count as a flood plain protection benefit the value of the land before and after the project. This ignores alternative sites for development. The correct benefit concept, which is well understood (but not used) by the agencies, is the difference in rents between the protected flood plain site and other sites that would be built on if the flood plain were not protected. In other words, the benefit is the net locational advantage of the protected flood plain, not the total appreciation in its value. The theory is clear, but the practice is weak.

I think it is the economists' responsibility not only to formulate good economic concepts but also to inquire why demand for their use is so small. It is my observation that poor project analysis won't be corrected until the political pressure groups concerned with the project see their interests differently. At present, in the preparation of a project report, the flood plain owners are sensitized as to the potential benefits to them. This becomes a political force as these people pressure their public representatives for the project. No one sensitizes the nearby upland owner to the fact that his land would have increased greatly in value if the predicted growth for the area materializes and the flood plain were not protected. The upland owner is thus not a political force and the economist stands alone as the abstract defender of the unknowing public interest. Somehow, the other interests must be informed and formed into effective political action, or the economic concepts will remain in the textbook rather than in government evaluation manuals. I believe there is an important role for extension education here which I will discuss more below.

The problem of owners striving to capture land appreciation from public improvements is not confined to flood control projects. This phenomenon distorts the planning for urban renewal, navigation projects, parks, highways, and urban land use [12]. I don't believe this pressure can be entirely neutralized by mobilizing owners of alternative sites. A fundamental reform in our concepts of who owns these appreciation values is in order. I believe that the public must capture some of this gain to prevent distortion of public land use planning and investment.

Part II: How to Get There

Organizing for non-marginal change

Once I would have said that the key to better public investments was to improve evaluation practices. Now, I believe that other things must be changed first. Already discussed is the role of educating new groups of affected people to change the present mix of political pressures. I believe this is the basic step, but others are also needed.

One of the basic problems is to present information and have it acted on in such a way as to facilitate consideration of alternative public programs. Former Budget Bureau Director Charles Schultze notes, "There is no mechanism by which Congressman and communities can forego pressing for a marginal public works project in return for a vocational education project . . . which may have a much higher payoff to the community" [15]. He argues that it is difficult to get programs which are geographically selective. To get a program passed requires something for nearly everyone even if the program has low priority for some. This encourages each community to get what it can from each program, even though it might prefer to give up some to get more of others.

I believe the answer to this problem is to have agencies make budget allocations first on a regional basis. Many Federal agencies have field offices that produce much of the information needed for program formulation. If a region were allocated a given budget amount for a five-year period, it would encourage explicit project tradeoffs within the region. There is always a tendency for a field office to recommend the currently available project and ignore better ones that are coming in the near future. But if they had a five-year regional allocation and a marginal project were available in the first year, the field office and its local constituency would be encouraged to recommend bypassing it for more wanted projects available in later years that are still within the regional budget constraints.

This system does not in itself make it possible to make tradeoffs between one agency program and that of others. However, within the regional allocation for the five-year period, the region is encouraged to consider water projects that are functionally selective as to geography and time. If all agency budgets were made in a similar fashion, it might facilitate functional trade-offs of a broad character. Groups of Congressmen could then see the budget going to their region and could ask themselves if the mix of programs is best for them instead of seeing the game as getting their share of every program each year, even if it has relatively low priority in the region.

All of this will appear nonsensical to the analytic purist. If Congress could rely on evaluation procedures to produce meaningful benefit-cost ratios, it could just go down the list after deciding on the budget level. But, alas, as I have already noted, this world is not that way. And I don't believe the evaluation procedures will get better until some of the other rules of the game are changed.

This will require a non-marginal change and will be difficult to institute. I observe that the PPBS activity and multi-year planning in the Federal government is not widely used. Still, there are hopeful signs. If one looks backward, there have been some attempts to organize decisions to facilitate regional tradeoffs. In 1950, the President's Water Resources Policy Commission recommended a Board of Review that "would propose allocations of the total investment, basin by basin, to the construction agencies . . ." [9, p. 90]. In 1955, the House Public Works Committee was organized for a time on regional rather than agency lines, and the budgets for the Corps of Engineers and Bureau of Reclamation were considered together by the same regional subcommittee. Looking at the present and future, the Department of Army has utilized budget allocations to regions in its civil works program [16, 17]. On May 21, 1969, President Nixon established coterminous field administrative regions for the Department of Labor, HEW, OEO, HUD, and SBA [8].

Irrational drive for rationality?

Economists have a learned, if not congenital, bias in favor of explicit decision making. We like to see objectives clearly laid out and alternative programs noted and a sharp choice made. Many government bureaucrats and other politicians seem to prefer obfuscation. Decisions seem to ooze out of the system. Surely in the end there are tradeoffs, but they are seldom clearly perceived as such. This difference does not make economists greatly loved in Washington or other halls of government. Instead of simply feeling superior, I feel we must inquire deeply into the preferences about explicit rationality.

Decisions are made by people and interpersonal relationships are important in and of themselves. One advantage of obfuscation and vaguely defined decision is that it is harder to tell who won and who lost. It is personally advantageous to some participants if it appears that everyone wins, even if in fact this is not the case. *Explicitness heightens conflict.* And as the political scientist, Aaron Wildavsky, keeps reminding economists, conflict is a cost and a performance factor to be considered in evaluating the output of a system [19]. Maybe economists have a higher tolerance for conflict than bureaucrats; or our stance may be the result of advising from afar, where the costs of conflict and defeat are never directly felt.

While I acknowledge the validity of Wildavsky's point, I think it can be carried too far. Conflict is a fact of life unless people all have similar tastes and there is no scarcity. The fact that two mutually exclusive acts cannot be pursued simultaneously can be covered by confusion and ignorance, but the consequences will remain even if they can't be causally identified. I perceive a lot of frustrated people in the United States who believe that all is not right but who can't identify the cause of their discontent. Oh yes, there are those who claim it is all caused by too much permissiveness, the availability of sex education, or a liberal Supreme Court. But this type of nonsense is what you would expect if the real conflicts and choices are not clearly perceived. The cost of concealed conflict over real tradeoffs and alternatives is a public that flails out in all directions and is unaware of the cause of their troubles. While the warning that explicit tradeoffs may raise conflict levels is worth noting, I am not sure that a public which is not clear on causes of discontent will avoid fights. Fights over vaguely perceived issues may be less productive than other kinds.

Conclusion: toward a client-centered political economy

The day of the lone academic scribbler who affects practical affairs by the sheer weight of his professional publication is over, if indeed it ever existed. I do not believe that research results can just be thrown on the market to be used by a undetermined consumer at an undetermined time. Demand must be cultivated, as for any product. The same can be said for extension education. The time to do research and extend it is in the context of particular problems. For example, further general studies of alternatives to flood plain protection are next to worthless. The government agency who one might hope would use them will be powerless to do so, as I have already noted. It will be most effective if it can be used to sensitize some of the potential interest groups not now comprising effective political forces. If these groups can be brought to life, there will be some chance to revise agency evaluation practices.

I believe that research and extension must be done more in a team context, with producers and users closely anticipating each other. I shall call this a client-centered political economics. This group effort at times must include not only academic and government researchers, but also congressional staffs, local planning officials, and private groups. The immediate cry will be that the researcher will lose his objectivity if he becomes involved in anything more than dumping his new information on the market. I am aware of this danger, but also impressed by the other danger of irrelevancy.

In conclusion, I am not optimistic that we can either develop a non-marginal analysis to look at large changes in the resource base through public investment or create new institutions to achieve non-marginal policy changes. A friend of mine defines a non-marginal change as one that never happens. He may be right. Analysts often base their policy advice on what they think an aroused public might want if it were as well informed as the analyst. But the fact is that the public is seldom aroused and informed. It is disheartening to see a Gallup poll made a few days before the crucial Senate vote on the deployment of the anti-ballistic missile that estimated 58 percent of Americans were either unaware of the program or had not made up their minds about it [4]. If people won't become informed or make up their minds on this kind of issue, with its wide publicity, what chance do I have to get them interested or informed on the evaluation of flood plain benefits or the even more abstract question of the role of resources in economic growth?

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Natural Resources in Economic Growth: The Role of Institutions and Policies*

S. V. CIRIACY-WANTRUP

Focus of this Paper

DURING the last ten years, it has become the fashion among economists to emphasize the decreasing importance of natural resources in economic growth. This applies especially to the renewable resources used by agriculture [21, 23]. Use of these resources is strongly influenced by economic institutions, both in developed and undeveloped economies. It is not surprising, therefore, that there has been, in recent literature, a de-emphasis of the role of institutions paralleling that of natural resources. In the current mathematical models of economic growth, the role of institutions is not explicitly considered [11, 14, 10]. In a well-known book on transforming traditional agriculture [24], the author devotes the only two pages on the influence of economic institutions to land tenancy.[1]

Emphasis has shifted from natural resources and economic institutions to technological change or, in production function terminology, to "new" or "modern" factors of production. If institutions are considered at all, they are treated as factors furnishing services like other factors of production. Changes in the kind and quantity of institutional services are regarded as determined by an economic demand-supply scheme [22].

In accordance with my assignment, I should like to focus on this doctrine of the decreasing importance of natural resources and the relatively insignificant and passive role of institutions in economic growth. I should like to analyze its validity, inquire into its relevancy, and show its implications for policy in developing countries.

Decreasing Importance of Natural Resources in Economic Growth?

The doctrine of the decreasing importance of natural resources in economic growth is based on the observation, documented largely for the United States, that the shares of agriculture and of agricultural land in

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[1] According to Schultz, this influence operates solely through profitability of tenant farming. Profitability is regarded throughout as a "strong explanatory variable" [24, pp. 167 and 168]. Edmundo Flores' emphasis on land reform as the basic issue in increasing Mexico's agricultural productivity is explicitly rejected [24, p. 19].

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the national income have decreased in the course of economic growth. Two questions arise with respect to this observation.

First, does the fact that the income shares of agriculture and agricultural land have decreased in the United States since the last quarter of the nineteenth century mean that the income shares of all natural resources used by agriculture, including those used also by the rest of the economy, have decreased? Further, can the experience with the agricultural sector in the United States during a particular period of economic history be extrapolated to other sectors, other time periods, and other national economies?

Second, even if the first question can be answered in the affirmative, what is the meaning of a decreasing income share in terms of the "importance" of natural resources in economic growth? What are the implications for explaining, projecting, and influencing economic growth?

Let us turn to the first question. The natural resources used by agriculture are mainly land, water, and climate. All three are used also by industry, transportation, urban settlements, and recreation. For this reason, referring to differences in demand elasticities for the products of agriculture on the one side and those of the industrial, transportation, urban, and recreational sectors on the other and then equating agriculture with natural resources are not permissible.

Shifts of these natural resources out of agriculture into other uses proceed at different rates and with different geographical impact. In California, for example, the shifts of agricultural land and water into industrial, transportation, urban, and recreational uses is a relatively recent phenomenon but has progressed further than in other parts of the country [7]. This shift involves price increases for natural resources that are frequently a multiple of prices prevailing in agriculture. Admittedly, the quantities of land and water used in agriculture are still large compared with those used in other sectors.[2] But this relationship is changing in favor of nonagricultural uses.

Next, we may note that the decrease in the income share of agriculture in the United States took place in a period of history when the terms of trade moved against agriculture internationally for a number of specific historical reasons which are not likely to recur in the same combination. Terms of trade were affected by the expansion of agriculture into less-developed regions, the mechanization and intensification of agriculture in more developed regions, and, cyclically, by economic fluctuations—especially during the 50-year "cycle" connected with the name of Kondratieff

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[2] Because of these weights, the study by Goldsmith, Brady, and Mendershausen [12] shows a decreasing share of *all* land in the wealth of the United States, but this study applies only to the period 1896–1956 and is subject to a number of statistical difficulties with respect to comprehensiveness and valuation.

[3]. Cyclical effects are distorting when income shares of sectors and factors are compared for periods, such as census years, falling into different phases of economic fluctuations.

With respect to climate and the increasingly important group of amenity resources—such as scenic attractions, public parks, clean water and air, and wilderness areas—it is difficult or impossible to evaluate shares in national income and wealth because the market system furnishes prices only incompletely or not at all. Still, there is little doubt that the significance of these resources for the location of industry and nonagricultural residence—including second homes—and for the income shares going to transportation, communication, and other services has greatly increased in the United States during the same period for which a decrease in the importance of natural resources is being claimed. There is also little doubt that the price society must pay for safeguarding the quality of these resources is increasing greatly and will continue to do so in the future.

With respect to natural resources originating and mainly used outside of agriculture, such as minerals and energy resources, there is evidence that their income shares have increased in the United States in some periods and decreased in others [19]. Here, also, the effect of economic fluctuations is significant.

In summary, then, we should be cautious in extrapolating an observation that applies to agriculture and agricultural land in the United States during a particular period of its economic history to all natural resources, time periods, and economies. On the basis of the available evidence, the validity of such extrapolation appears at least questionable. The possibilities for such extrapolation depend on the type of natural resource considered, on the type of technological change that interacts with the resource, on factors affecting the terms of trade of the products of the resource, and, last but not least, on the degree to which the resource is integrated into the market system.

Let us now turn to our second question and disregard for a moment the cautionary remarks just made. What does the alleged decreasing "importance" of natural resources in economic growth mean for explaining and projecting economic growth and for public policy aimed at generating and influencing economic growth? The reply, I am afraid, must be that it is irrelevant.

A decreasing income share may be due to greater efficiencies in a sector favored by technological change, making its product cheaper—especially if demand elasticities are low—and/or releasing factors for other employment. Are we to argue that such a sector or the services employed in it have become less important for economic growth? The opposite would seem more plausible.

A decreasing income share of a sector, on the other hand, may be due to the growth of other sectors producing substitutes for particular uses. Historically, this has been the case in many minerals and energy resources (charcoal, bituminous coal, sperm oil, etc.). Still, this does not indicate that the individual natural resources replaced in particular uses and the larger groups of the natural resources to which they belong have become less important in economic growth.

The whole question of the importance or unimportance of natural resources in economic growth to which so much attention has been devoted in the last ten years, generously financed by some research foundations, appears rather banal. In the relation that one may call the resources function, all relevant variables are important [5, Ch. 3]. Nobody has yet claimed that natural resources are irrelevant in economic growth. In the continuously changing interplay of challenge and response between natural environment and human culture, it is meaningless to say that the challenge is less important than the response. Both are a part of the same system—that of human ecology. If there were no challenge, there would be no response. And, I may add, challenges may yet appear that will prove overwhelming to the response.

The Role of Economic Institutions in Economic Growth: Factors or Decision Systems?

The remainder of my allotted time will be devoted to a more meaningful subject—the role of economic institutions in economic growth. In this connection, the mathematical models of economic growth need not be considered because, as stated above, economic institutions are not a part of their input. The output from a mathematical-statistical formulation depends on its input. If one is interested in explaining economic growth as a historical phenomenon and in development policy in the political reality of today, such models have little to offer. Good critiques by economists concerned with development policy are already available.[3] Rather, I should like to focus on the treatment of economic institutions in the book on traditional agriculture mentioned earlier.

To avoid misunderstanding, the main theses of the book are not under discussion. Within the assumptions and terminology employed, traditional agriculture can be regarded as efficient; and its marginal productivity of labor is greater than zero. Neither is it my main criticism that technological change is segmented into "new" factors in order to speak of "shifts" of a global production function—although understanding is scarcely advanced by such terminology.[4] Historically, technological change has pro-

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[3] See the discussion of the Ranis and Fei and Jorgenson models by John W. Mellor [17]. Also, see the discussion of institutional influences by John M. Brewster [2].

[4] Since multidimensional relations are involved, one must, strictly, speak of movements to production hypersurfaces.

ceeded through packages of interrelated changes of many factors. The nature of these interrelations over time, the *Gestalt* of technological change, if you like, is the phenomenon that needs understanding rather than the appearance as a *deus ex machina* of quantities of "new" individual factors. I mention this merely because institutions are subjected to the same segmentation as technological change. My main criticism is that the book presents a conceptually insufficient model of economic growth because the role of institutions is left out.

Sometimes the author himself seems vaguely aware of this insufficiency. He is "puzzled" by economic decisions under a feudal land-tenure system and "baffled" by the economic behavior of plantation owners under a system of slavery.[5] Still, none of the economic institutions that are significant for resource use—such as the systems of owning and using property, the systems of water rights, taxation, collective and cooperative organizations, and quasi-governmental agencies like public districts—is mentioned, much less systematically treated. Economic growth proceeds in an institutional vacuum as far as natural resources are concerned.

Is this vacuum filled by the belated admission of institutions as factors [22, p. 1117], the services of which are supplied in kind and quantity in accordance with the demand for them until a demand-supply equilibrium is reached?[6] This comforting notion is presented as a "theory" in a field in which it is claimed that "there are virtually no terms of reference, concepts with specifications that can be identified and no economic theory to guide the analysis" [22, p. 1114]. The facts are quite to the contrary. Institutions have been the central focus of the study of social organization for more than a century, both by adherents of the theory of economic determinism of institutions and by its opponents.

While Marx, Engels, and Kautsky emphasized the role of technological change in economic growth and the economic determinism of institutions, they, as well as non-Marxian adherents of economic determinism, were too aware of the relations between economics and social organization to press institutions into a simplistic demand-supply scheme.[7] They recognized that the demand for changes of institutions is always opposed by demand for the status quo or demand for change in the opposite direction. They recognized also that a new equilibrium between conflicting demands on the one side and institutional change on the other is a long and hard struggle and is brought to conclusion by political rather than economic forces and tools.

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[5] "Why many of the farmers who own and are responsible for the operation of very large farms, especially in some parts of South America, do not successfully engage in the search for modern agricultural factors is a puzzle" [24, p. 174]. "Why better health and longer life were not realized [for slaves in the antebellum South] is baffling" [24, p. 180].

[6] The author must be aware that the economic definitions of demand, supply, and equilibrium do not apply in the cases he discusses. Clarity is not served by interchanging the more general sense of a word with its precise scientific connotation.

[7] Compared with Marx and Engels, Kautsky has not gained a wide reputation in this country. He was, however, an economic theorist of some stature, who was especially interested in the role of agriculture in economic growth [15, 16]. Besides Marx, Engels, and Kautsky, a long list of non-Marxian works could be mentioned. The best known in the United States is probably Charles A. Beard [1].

The position of scholars who do not accept the theory of economic determinism of institutions—like Emile Durkheim in France; Max Weber, Werner Sombart, and Eduard Hahn in Germany; and W. I. Thomas and Talcott Parsons in the United States—is not affected by this recent oversimplified version of economic determinism [10, 13, 18, 25, 26, 27, 28].

What, then, is the essence of economic institutions? We may conceptualize an institution as a social decision system that provides decision rules for adjusting and accommodating, over time, *conflicting* demands (using the word in its more general sense) from different interest groups in a society. A change in the demand from one interest group, therefore, rarely effects a change in institutions. A feudal land-tenure system does not change merely because serfs or tenants demand it. A water-rights system based on the riparian doctrine does not change simply because nonriparians demand it. A system of taxation does not change because one or even the majority of taxpayers demand it. It all depends on the effectiveness of different demands, that is, on the relative weight of the interest groups from which demands originate. The locus where conflicting demands meet and where the relative weight of interest groups is determined is the political arena rather than the marketplace. For this reason, changes in economic institutions are usually slow and often require political changes and sometimes outright revolution. Changes in the feudal land-tenure system in Europe took centuries. In South America the change of similar land-tenure systems is still in progress. A hundred years after abolition, the economic effects of slavery in the United States are still present. It took half a century and required a constitutional amendment for the appropriation doctrine to obtain co-equal status with the riparian doctrine in the water-rights system of California· Tax reform in the United States is talked about for decades; but as every newspaper reader knows, accomplishments are slow.

Demands for institutional change may not even originate from those groups directly involved, such as the landlords and tenants in tenure systems. The demand may come from other groups because of what one might call the externalities of land tenure—that is, the benefits and costs incident on social groups other than landlords and tenants. This is frequently true for the collectivization of agriculture in order to promote industrial growth and the stability of a socialist political system. Other examples are tenure changes in fugitive resources—such as fisheries, range, oil, and gas—to further the social objectives of conservation. We are presently studying a case of this kind for a nomadic group of tribes in East Africa—the Masai. Here, tenure changes are demanded by the government in order to conserve the range resource and the game herds sharing use of the resource with the Masai livestock. The game herds, in turn, are important for economic growth as the basis for a flourishing tourist trade and large foreign-exchange earnings. If the demand for institutional change originates outside the groups directly involved, the changes required are even more clearly political and sociological and usually involve various degrees of "persuasion."

Economic institutions conceptualized as social decision systems provide decision rules both for the use of resources and for the distribution of the income stream derived from such use. This distribution has strong effects on the demand for institutional change. But such income effects are frequently just the opposite of those claimed by the doctrine under discussion. In other words, the demand for institutional change is increased if the income stream of a social group is decreased absolutely or relatively. The demand for changes in the feudal system in Central Europe was increased through dispossession of the peasants in the course of enclosures, and the demand for labor legislation in England was sparked by the misery of the working class during the first stages of the industrial revolution.

Our conceptual framework is not complete by designating economic institutions as social decision systems. I have tried to show elsewhere that economic institutions operate on the second level of a three-level hierarchy of decision systems [9]. Understanding of the relations between the three levels is necessary for devising public policies. On each level, the structure, the functioning, and the performance of the decision system can be studied both conceptually and observationally. For economic institutions affecting private conservation decisions, that is, decisions on the first level, such a study has long proved its usefulness [5]. Water institutions likewise have been analyzed within this framework [4, 8].

To bring this framework closer to the realities of development policy, I should like to illustrate it by some observations regarding the role of water institutions in northern India under the impact of the green revolution—the rapid spread of a new cereal technology based on varieties with greater capacity to combine with complementary inputs, such as labor, fertilizer, and especially water. Because of time limits and because our study is not completed, I can only sketch the main issues.

The Role of Water Institutions in Northern India Under the Impact of the Green Revolution

The results of the green revolution, expressed in yields per acre, increase in acreage of high yielding varieties, and total production, need not be recounted here. This revolution has spread so rapidly in northern India, Mexico, and several other countries because it requires the least institutional change of any new technology that I know of—at least in the initial stages. In subsequent stages, however, institutional changes will become necessary. Of these, changes in water institutions will be the most essential and the most difficult to bring about.

My concern is that the doctrine discussed in the preceding sections will lead to complacency regarding the institutional difficulties that lie ahead in realizing the full benefits of the green revolution and avoiding serious setbacks. According to this doctrine, there are no such difficulties because farmers themselves will accomplish those changes of water institutions that become necessary.[8] Let us take a closer look at this projection.

In northern India, irrigation has been based for centuries on groundwater lifted from open wells by the Persian wheel, a simple but ingenious device to develop groundwater resources where they are available in large quantities not more than some 40 feet below the surface. This is the situation in large parts of the extensive Indo-Gangetic Plain.

Groundwater use is usually possible on a more individualistic basis than surface water use. This is especially true for the relatively small, low-capacity development of groundwater based on the Persian wheel. The farmer can build, maintain, and operate the water facility himself or with the help of a small number of villagers. Water is available to the individual farmer where he wants it, when he wants it, and in quantities and over time periods that are under his own control.

An irrigation economy dominated by the Persian wheel differs greatly from one that is based on diversion from large rivers, such as in ancient Egypt and Mesopotamia, or, in modern times, from large multipurpose reservoirs. Here, the individual farmer is dependent on other farmers for building, maintaining, and operating the diversion facilities and the canal system that distributes the water. He must take his water at certain points on the canal. He must take his turn as to when the water is available to him. Quantities of water are rationed to him, and these rations may vary over time for reasons outside his own control. What is the effect of these fundamental differences in the irrigation economy on the development of water institutions?

In a diversion economy, water institutions—such as water rights, water districts, a water master, and public agencies engaged in building, maintaining, and operating facilities—are a necessary condition from the beginning. In a water economy based on the Persian wheel, such institutions are not needed and do not develop. Groundwater institutions become a necessity only when water use by one farmer affects his neighbor. This happens when the Persian wheel is replaced by modern deep-well pumps. Here the neighbor is affected by the pumping cone and by the seasonal and often secular depletion of the resource because of high-capacity pumps.

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[8] As Professor Schultz puts it, farmers "will join with neighbors to acquire tube wells and to undertake minor investments to improve the supply of water. Both tenants and landowners will also use whatever political influence they have to induce the government to provide more and better large-scale irrigation facilities" [22, p. 1118].

In countries where an irrigation economy based on diversion preceded the need for modern groundwater institutions, these institutions could be built on the experience and mental attitudes already formed. These relations between groundwater institutions and surface water institutions I have traced elsewhere [6]. But such experience and such attitudes are not available in northern India. There, water institutions must be created from scratch.

The green revolution has created a need for more water. Groundwater tables are beginning to fall and will force the replacement of the Persian wheel by deep-well pumps. Increasing size of farms, related to the green revolution, will operate in the same direction because of the Persian wheel's relatively low capacity and high labor requirements. Increased irrigation will increase the need for drainage. Water allocation problems between users, between uses, between states and regions, between areas of origin and areas of destination, and between state and federal jurisdictions loom on the horizon.

To solve these problems, groundwater laws are needed to regulate the number and spacing of wells, the quantities pumped per well, the periods of pumping, and the provision and operation of recharge facilities. This will require adjudication of water rights and integration of groundwater and surface water development and, thus, an integrated water-rights and management system.

As a key element of such a management system, the water district has proved its usefulness in the United States and elsewhere. It is flexible with respect to its role as a part of local and regional government. It is flexible also with respect to the participation of social groups outside of agriculture that need additional water supplies. Water districts, possibly with greater governmental participation and supervision than in this country, are needed.

Water institutions of this kind will develop over time. But the individualism of the farmer, the local community, and the region, shaped over centuries in an irrigation economy dominated by the Persian wheel, requires a special effort by researchers and policy-makers to create and to make acceptable the water institutions that are needed. Complacency based on a simplistic doctrine of the role of institutions in economic growth is not at all warranted and will become dangerous if effort in research and in public policy is thereby deflected from this important area.

What India's agriculture needs most at the present juncture are competent economists, fully aware of the intricacies and the difficulties in the development of water institutions. Otherwise, the cornucopia of the green revolution may indeed prove Pandora's box, to paraphrase the title of a perceptive recent paper [29]. A laissez-faire attitude toward institutions is no less inappropriate than regarding them as constraints.

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POLICY AND NON-POLICY IN FOREIGN TRADE

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Technology and Neo-Mercantilism in International Agricultural Trade

H. B. MALMGREN AND D. L. SCHLECHTY

WHILE developments in agricultural trade in this decade have been reasonably favorable, the underlying trend and some recent developments suggests a very difficult and dangerous period ahead in the 1970's. The results of the Kennedy Round trade negotiations were clearly beneficial for certain commodities. Agricultural trade has generally been increasing. Among the OECD countries, which are the major trading countries, it increased by 6.5 percent per annum from 1960 through 1967 [5]. But in spite of this overall progress, some of the general problems raised by other writers in the recent past are even more threatening now [2, 4]; and there are technological and policy developments that add new complex dimensions.

All countries were aware of the need to provide for expanding trade opportunities for agriculture during the course of the Kennedy Round. However, the substantive negotiating sessions in agriculture came too close to the end of the Kennedy Round talks to allow time for negotiating fundamental changes in access to markets or in national farm policies. The liberalization that took place was therefore modest in character.

The New Mercantilism

During this period the general level of protection in the European Economic Community (EEC) rose as a result of the implementation of the Common Agricultural Policy (CAP). The degree to which that protection has risen for some of the major farm commodities has not been fully realized. If the total charges of the variable levy system at the EEC border are converted into ad valorem equivalents, some interesting comparisons can be made between the pre- and post-CAP protection levels (see Table 1): For BTN Chapter 1, Live Animals, protection rose from 14 percent in 1959 to 49 percent in 1968; for meat, the rise was from 19 percent to 52 percent; for dairy produce, from 19 percent to 137 percent. Though not shown sep-

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Table 1. Comparison of pre-CAP and post-CAP level of import protection (tariffs and other direct charges) for agriculture in the European Economic Community[a]

BTN[b] chapter	Commodity	Common external tariff	
		Pre-CAP	Post-CAP
		percent	*percent*
Live animals, animal products			
1	Live animals	14.4	48.5
2	Meat, edible meat offals	19.0	52.1
3	Fish, crustaceans	16.6	13.3
4	Dairy produce; bird's eggs	18.6	137.3
5	Products of animal origin	.1	.1
Vegetable products			
6	Live trees, other plants	13.6	10.8
7	Edible vegetables, roots	12.0	12.8
8	Edible fruit, nuts	15.9	14.5
9	Coffee, tea, mate, spices	16.3	9.8
10	Cereals	13.5	72.4
11	Products of the milling industry	22.8	20.9
12	Straw, fodder, misc, grains	.6	.6
13	Vegetable dyeing material	1.1	1.1
14	Vegetable plaiting materials	1.1	.4
Animal and vegetable fats			
15	Animal and vegetable fats and oils	8.3	9.5
Prepared foodstuffs			
16	Preparations of meat, fish	20.1	20.4
17	Sugars, sugar confectionery	75.8	41.9
18	Cocoa, cocoa preparations	10.3	7.8
19	Cereals, flour, or starch	28.8	27.8
20	Preparations of vegetables, fruits	25.5	25.9
21	Misc. edible preparations	21.4	19.9
22	Beverages, spirits	21.6	37.7
23	Residues and waste	2.4	3.9
24	Tobacco	35.5	22.9

[a] Data for pre-CAP protection (1959) taken from report by Committee on Economic Development, *Trade Negotiations for a Better Free World Economy,* Library of Congress Catalog Card No. 64-20846, page 79. Post-CAP protection estimated from pre-Kennedy Round tariffs, adjusted to include 1968 import levies. Post-Kennedy Round tariffs would be somewhat lower for certain non-variable levy commodities.

[b] Brussels Tariff Nomenclature.

Source: Estimated from unpublished data in the world trade and tariff computer tabulations developed by the Office of the Special Representative for Trade Negotiations, Executive office of the President, Washington, D. C.

arately, for butter alone, the increase was from 30 percent, pre-CAP, to 350 percent, post-CAP. In cereals, the protection rose five times—from around 14 percent, pre-CAP, to 72 percent, post-CAP. In contrast with these phenomenal rises in the level of protection for major commodities, there have been some modest declines, mostly in complementary, noncompetitive imports, or in products where there has not yet been applied a common price policy or variable levy system. For the principal nonvariable levy commodities, like soybeans and soybean products, tobacco, and canned fruits and vegetables, the United States and other countries hold negotiated tariff concessions, and the introduction of the levy system would constitute an impairment of exporters' rights. Nonetheless, the EEC has contemplated breaking its undertakings and introducing the levy system, or introducing other protective devices which might have a major protective effect.

Because of these dramatic increases in the level of protection in the EEC, the Community is the most highly protected area for agriculture in the world. With the variable levy, the protection level is about triple that of eight or nine years ago prior to the CAP and many times above that in the other major developed countries.

There has been an argument often used by defenders of the CAP that the level of exports from the United States and other major traders would continue to rise, regardless of the "system," because of the rising demand for both food and feed. Until 1965–66, U.S. agricultural exports to the EEC did indeed continue to rise. But since then there has been a reversal, and we now appear on a downward path. In fiscal year 1969, total U.S. agricultural exports to the EEC were $1.3 billion, seven percent below that of fiscal year 1968. This represents a 19 percent drop ($300 million) in the past three years. The items subject to variable levies rose until the 1965–66 peak, when they totaled $737 million. The level for these same export products for fiscal 1969 is $441 million, a decline of nearly 40 percent in three years, while nonvariable levy items remained about the same. The rise until 1966 is also worthy of comment; until that time, there was no CAP for many products—only certain transitional price ranges. Towards the end of the Kennedy Round, the EEC, in a series of marathon sessions, reached internal agreement on common price levels, which tended to approach the highest individual country level. Consequently, the new import protection levels had also to move up dramatically. Thus, the real bite of the protective mechanism of the Community's CAP was not really felt until the common prices began to be reached in 1966 and 1967.

This is not the whole picture, however. While increasing its import protection, the EEC has simultaneously been raising its level of domestic production. Both yields and total production of the major commodities have been rising rapidly (Table 2). The rapid growth in output has been encouraged by high support prices and protected by a levy system which essentially converts imports into residual supplies. The support prices for cereals, for example, are about double the average world market level. Total EEC grain production has risen 20 percent in this decade, largely

Table 2. Index of EEC production and yield of selected agricultural products by year[a] (1959-60 = 100)

Item	1959 -60	1960 -61	1961 -62	1962 -63	1963 -64	1964 -65	1965 -66	1966 -67	1967 -68	1968 -69
Total grain										
Production	100	92	86	100	98	103	104	101	117	120
Yield	100	102	96	109	110	115	115	113	132	134
Wheat production	100	94	89	114	94	113	118	102	120	125
Yield	100	95	96	114	103	114	120	109	134	132
Total course grain										
Production	100	109	99	105	120	113	111	118	138	137
Yield	100	109	96	106	117	116	115	117	132	138
Barley production	100	113	106	126	139	136	137	183	177	177
Yield	100	109	93	111	112	115	112	108	132	127
Corn production	100	116	112	90	133	107	119	139	143	164
Yield	100	110	98	87	122	103	119	135	125	150
Milk production	100	107	110	113	113	113	117	121	125	128
Yield	100	104	105	106	109	110	113	116	119	120
Butter production	100	113	108	111	125	124	132	132	141	150
Nonfat powdered milk										
Production	100	202	236	291	362	416	570	696	939	1,180
Poultry meat production	100	114	126	139	148	174	193	207	218	225
Grain meat ratio[b]	na	na	3.5	na	na	na	na	na	na	2.2

[a] Grains production figures shown for crop year (July-June); all other figures for calendar year.

[b] Pounds of grain required to produce one pound of poultry meat; 1962 figure represents approximate grain/meat conversion ratio in the Netherlands. 1968 figure estimated on basis of trade information.

Source: U.S. Department of Agriculture, *Grain Developments in the Common Market*, FAS M-202, Dec. 1968, and various Foreign Agricultural Service commodity circulars.

on the strength of a 34 percent improvement in yields that also reflects new technologies. Total coarse grain or feed grain production rose 37 percent since 1960 and yields increased by 38 percent. The rising internal production in turn results in pressures to expand exports. With the high internal market prices, exports would not be possible without some special export assistance mechanism. The so-called restitution system of export payments was designed to carry out this function. Initially, the concept of the Common Agricultural Policy was that of a system with high prices, like an island in the sky, with a bridge up to that island in the form of the variable import levy system, and a bridge back down to the world market level via restitutions. Restitutions were theoretically to be established at a level equivalent to the import levies. On a feed product, such as poultry, exported chickens would theoretically benefit from a restitution payment equivalent to the import levies on the feedgrain incorporated in the exported birds plus a standard amount. In practice, however, the restitution system has lost this theoretical tie to the import levies in many cases, and the restitution payments are often simply set at levels sufficient to make the export competitive in any market of destination. In other words, the payments have no technical limit in some cases, designed as they often are now to beat the best price of the lowest competitor.

These restitution payments, or subsidies, have been especially troublesome in certain commodities: poultry generally, barley and wheat into the Far East, lard into the United Kingdom, dairy products to all destinations. The outlook is that these subsidies will be even more aggressively used in grains generally, as EEC surpluses begin building up to serious levels.

The poultry problem is a good example of the dangers that can result from this system. Import protection was tripled through the introduction of variable import levies in 1962. This brought about a substantial drop in imports ($33 million in one year from the United States alone). On the other side, as EEC subsidies necessarily affect the position of all poultry exporters, the Danes, who are major exporters, have been encouraged to continue and expand their own subsidy system (known as the "Home Market Scheme"). Importing countries in turn, having some home production of their own, are under pressure to increase the level of import protection if their markets are relatively open to imports. The Greeks established their own variable levy system to protect against such abnormally low-priced imports, and the Austrian Government recently introduced a minimum import price scheme of its own. In reaction to this highly distorted situation, the U.S. Government resumed its own poultry export subsidy into Switzerland in 1968, to make our exports competitive and at the same time dramatize the absurdity of the subsidy policies of other countries.

Thus, the dimensions of the protectionist, mercantilist aspects of the CAP go far beyond the question of the import levy system itself. The CAP system could have been operated in a less damaging manner. For example, the import levies could have been used to limit distress selling, or abnormal pricing by state trading nations. But the Europeans seem in practice to have opted for a much more import-protective and export-aggressive usage of the system. Because of excessively high protection, exporting countries find themselves competing more intensively in other markets to which they are diverted. Compounding this problem, EEC subsidies put heavy downward pressure on market prices for exports into third markets. The CAP has thus become truly mercantilist: its workings result in reduced imports, increased home production, artificially assisted exportation, and discouragement of exports of other countries into third markets.

These developments would be harmful enough by themselves. But there is the real likelihood that the practice will spread. Both political parties in the United Kingdom are advocating increased self-suffiency in agriculture. The minimum import price scheme, which was introduced in 1964 for grains, is highly protective. The Economic Development Committee for Agriculture was established to develop import-saving policies. The Ministry of Agriculture has followed its general proposals to stimulate home production and has agreed to pursue policies to cut back imports of agricultural products to save about $400 million annually by 1972–73. In the next year or two, the nature of import protection will be reviewed if the U.K.-EEC negotiations take place, leading toward the entry of the United Kingdom into the Common Market. The likely result of U.K. entry will be adoption of the variable levy system and an alignment to high support prices. This will raise the level of protection on agricultural imports into the United Kingdom, encourage home production of cereals and meat, encourage purchase of French and German wheat and feed as a substitute for imported wheat and feed from third countries such as the United States, and thus further increase competition in the remaining markets. Moreover, the costly accumulation of surpluses within the EEC could be greatly relieved by this opening of the U.K. market, especially for grains, dairy products (particularly butter), and sugar. With a reduction of the pressures on the member countries of the EEC resulting from costly stockpiling, there is less likelihood of a fundamental change in the EEC's own internal policies.

In Japan, a major agricultural importer and the largest market for U.S. agricultural products, the trend was good until about 1966. But Japan also is now suffering from the consequences of high support prices, mainly in rice (the rice support being nearly triple the world price level). There must soon be domestic diversion of production to other commodities to relieve the indigenous rice surplus being acquired by the government at great cost. This could easily result in increased pressures for new protection measures or at least maintenance of existing agricultural quota restrictions which are contrary to Japan's GATT obligations. The implications of the rise in rice supplies alone could be broad. First, there is consideration of a curtailment of wheat imports, as recommended by the Japanese Federation of Agricultural Cooperatives. Second, imports of rice, which dropped to insignificant levels in 1968–69, will tend to remain very low, weakening the world demand for the increased rice production of the developing countries. Third Japan will grant some of its food aid commitments under the International Grains Arrangement of 1967 in the form of rice, which will detract from the development of intra-LDC trade in rice.

The developments in other major producing and trading countries are also in the same direction, particularly in grains generally. The one positive sign in terms of changing public attitudes toward production restraints is in wheat, in Australia and Canada. The change here is rapidly becoming necessary because of shortages of storage capacity and rapidly increasing world surpluses of wheat.

Even in the United States there have been growing pressures for increased agricultural protection. Existing protective systems have been used more actively in the last two years. In the case of dairy imports, emergency quota action was taken against certain dairy products, including some types of cheeses in addition to those already under quota. The main reason was the extraordinarily low price levels for some of the imports, resulting from large subsidies by the EEC and certain other countries. Given the enormous surplus of butter in Europe, it is not surprising that the EEC was tempted to try to move butterfat in various forms with the use of unusually large export aids. Nonetheless, in spite of the reasons for the U.S. actions, it can be said by other countries, with some justification, that our overall quota levels for dairy imports are excessively restrictive, holding imports to about one percent of domestic production. In beef, the present quota legislation, introduced in 1964, does not formally apply, since imports have not reached the so-called trigger levels that would bring quotas into effect. However, imports have recently been very close to the trigger levels. Consequently, the Executive Branch was forced to warn exporting countries in 1968 that they would bring quotas into place unless they restrained exports below certain specific levels. In this way, an informal, voluntary quota system came into effect in 1968 and is still operating. The result has been significant restraint on the levels of exports from both traditional exporters (Australia and New Zealand) and from a number of developing countries in Latin America.

Economic Regionalism

These forces are working themselves out in conjunction with another set of mercantilist forces arising out of economic regionalism. Clearly, when nations join together in a trading bloc, there is the danger of trade diversion as well as the prospect of trade creation. The effects of the CAP on world trade have been changing. As already suggested, the odds are great that U.K. entry will exacerbate the difficulties. There will consequently be considerable incentive for other neighboring countries to become part of the system, opening these markets more directly to the EEC member states while closing them to third country exporters like the United States. The costs will be high to such new members, but those countries seem willing to pay the costs. Moreover, if the political decision is put frankly, it is a question of accepting a heavy price for agricultural readjustment in exchange for greatly improved industrial access and exposure to the kinds of competition which ought to stimulate industrial growth. Since countries like the United Kingdom are necessarily faced with major agricultural adjustment needs anyway, and those adjustment programs that are being given consideration are already protectionist in character, there is doubt that the agricultural costs will ultimately deter entry.

Economic regionalism has had its bad effects felt in agriculture elsewhere. The increasing preferential tendency between the EEC and other countries is having a diversionary effect in a number of commodities. The preferences of Greece and Turkey, unjustified by any reasonable construction of the allowed types of association in the GATT rules, have an adverse effect, as do the special relations with African and Mediterranean countries. Within 1969, for example, the EEC arranged for new preferences on citrus products from Tunisia, Morocco, Spain, and Israel, which results in discrimination against numerous other suppliers, including the United States. More recently, the EEC decided to seek establishment of a general preferential arrangement with Spain and Israel.

The developments among the developing countries have not been favorable to third countries either. One of the effects of the Latin American Free Trade Area has been to raise the protection against certain agricultural products from outside the group while providing preferred access to those within. Of course, if the LAFTA were a true customs union, preferential access among the members would be acceptable. But it is not a customs union, and there is little prospect of it becoming so in the reasonably near future. In the meantime, outsiders have been harassed by a variety of problems. For example, U.S. exporters of fresh fruit face increasingly high, or prohibitive, import barriers into the Latin American economies, while some of these same countries export to the United States in increasing quantities, as well as to each other.

This tendency toward regionalism is growing. It need not necessarily result in damaging distortions to third country trade, but it has tended to do so thus far in agriculture.

The Role of Technological Change

Past improvements in technology, leading to steadily improving yields, have played a significant role in the rise in world production. But those developments have been orderly until recently. In the next few years, world grains production, particularly in Asia, will be greatly affected by the recent introduction of the new high-yielding varieties of wheat and rice. The area planted to these high-yielding varieties in Asia, for example, have increased substantially from 4 million acres for the 1966–67 crop year to 27 million acres for the 1968–69 crop year [8]. The impact of these new varieties will be great, though the exact dimensions are as yet uncertain [3, 7]. The developing countries are not only hoping that use of these varieties will bring about a quantum change in their economic position; they are actually planning on major changes. A number of them expect not only to reduce imports drastically, but to become self-sufficient and to begin exporting on a large scale. The change from net importer to net exporter position for some of them is part of their overall economic development plan.

Questions immediately arise: What will be the effect in terms of adding to the world commercial grains surplus? Will the increasing self-sufficiency of some of the larger developing countries mean the reduction of world market potential, instead of the rise some had hoped for in previous years? Will world trading prices, already subject to the pressures of export subsidies and production stimulation policies in the developed countries, be further depressed by the rising commercial position of the developing countries? If so, will this bring about the same kind of mercantilistic policy reactions in the developing countries as has been seen in the developed countries, with all the consequent heavy costs of export subsidies and income support programs?

Another set of problems arises out of the international transmission of new technology. One of the best examples is again the case of poultry. The newer methods of chicken production were first introduced in the United States. Americans then provided technical assistance to Europeans with a view to increased sales of feed and chicks. The improved efficiencies in European production might have reduced the pressure for higher levels of protection as a result of the declining cost of production. But this did not happen. Instead, increased capability to produce at home simply added to the pressure to substitute for imports. The less efficient producers who were subjected to increased competition from internal EEC competition insisted on increased protection against somebody—and the somebody had to be the outside world since the internal market of the EEC had to be free of restrictions. In some smaller countries, the improved technology provided increased incentives to shift over to, or remain in, poultry production. With the advent of increased production and heavy export subsidies from the major exporting countries, such countries found themselves with a semi-efficient industry suddenly challenged by artificial prices and in need of protection. Thus, the steady transfer of technology from the countries originating new methods to other countries has often simply added further protectionist incentive.

A third set of problems now facing us is the changing technology of animal feeding. Much of the change has of course been spurred by the changing price differentials among various feeds, which in turn were brought about by national policies. Countries are increasingly feeding wheat (and even recycling milk products back) to cows. New feeds are also able to make inroads. Fishmeal has been making major gains. The use of urea, one of the newer developments in synthetic feeding, is taking hold.

The combined effects of these three developments cannot be gauged at this time, but it is clear that major readjustments in trade patterns in the 70's are likely to arise out of these forces of changing technologies.

International Adjustment Problems

The technological developments, both those of longer term, steady improvement character, and the more recent quantum changes such as those made possible by the new varieties of food grains, should theoretically have reduced protectionist pressure. As efficiency improved, it might be expected that the need for individual product protection would be lessened. Events have not unfolded in this way, however. One response in Europe to increased efficiency and increased production has been to seek to raise the level of protection and of export aids. Another response to the production rise has been the conscious restructuring of price differentials between food and feed grains. The objective in Europe is to make corn expensive and wheat relatively more cheap for feed, so as to substitute wheat for imported feedgrains.

The general improvement in agricultural production coupled with a less rapid rise in demand will mean increasing supplies available for export. A recent OECD study indicates that the major developed countries have the prospect of expanding food production well beyond their own needs, without any changes in policy. For example, the net export availability of grain of the OECD countries plus Oceania would rise from 20 million tons in 1961–63 (6 percent of production) to 90 million tons in 1975 (19 percent of production) and 121 million tons in 1985 (21 percent of production) [6].

Against this background, the consequence of the interaction of conflicting national and regional agricultural policies will be to create a major world trade and production adjustment problem. The present crisis in world dairy trade, characterized by heavy surpluses and extensive subsidization, is not an isolated problem. It is simply an example of the adjustment problems to come in other commodities. Particularly in wheat and rice, the increased self-sufficiency objectives of many countries, both developed and developing, will limit the opportunities for unloading domestic surpluses of those countries which traditionally export. The developing countries, who have put so much of their hopes on the Green Revolution, may confront a very difficult market. Moreover, the possibilities for relieving their difficulties through regional arrangements with other developing countries are endangered. One of the major incentives for regional cooperation would have been sale of agricultural commodities; but if these nations become more or less self-sufficient, they may have substantially reduced incentives to work more closely together.

One of the major adjustments will be a consequence of the slowly changing relationship between food and feedgrains, as foodgrains are increasingly utilized as feed ingredients because of the rapid rise in wheat and rice production. One of the interesting analytical questions on which there has been little work, is the relationship between rice and wheat, and the relationship among rice, wheat, and feedgrains taken together. Looking at the adjustment problem generally, some countries are tending to see their salvation in increasing production of animals, and increasing demand for animal proteins in the diet. There is room for maneuver here, but countries may well follow again the patterns of the past and attempt to make the adjustments behind increasing protection, thus starting a new cycle of major adjustment problems.

A major force, which eventually ought to push countries toward consciously planned and economically efficient adjustment policies, is the rising cost of domestic production policies and export subsidies. But these costs can continue to rise for a time in some countries. In the EEC, the home costs are far higher than they appear. The national programs are additional to the Community programs, and many of the national programs are buried in the budgets of many ministries in addition to the agricultural ministry. Moreover, consumers pay a significant portion of the costs through the very high level of prices. A not unreasonable estimate done informally within the U.S. Government sets the cost of the Common Market agricultural program at about $15 billion a year.[1] Of course, any such estimate of cost does not reflect the cost of diversion from alternative resource allocations that could have higher social and economic returns. So long as the costs are diffuse and difficult to pin down, there will remain room for further rises. Moreover, taking into account the political objectives of the European Community, there are many who argue that the farm costs are simply part of the political cost, and that an appropriate mercantilistic use of the CAP mechanism will relieve much of the burden. Since export subsidies are at least in part financed by import levies, they argue that further room for increased subsidization exists. Others argue that it is cheaper to subsidize almost to any level, rather than build storage and incur storage costs where surpluses exist. For a time the United States can step up the cost pressure on other countries by lowering its export prices, either by increased use of subsidies or by decreased support prices in the United States. This indeed is a necessary ingredient in the search for an easing of the conflict in national policies, because the costs to other countries will probably have to rise somewhat further before they will be politically prepared to make major policy changes. But this means that the world faces a kind of trade and adjustment problem that is most difficult—a problem the major powers can ultimately cope with, at great cost, but with which the developing countries and the smaller developed countries cannot unless there is some new international discipline introduced.

The Need for Coordination of National Policies

There is, then, urgent need for some new kind of approach to international negotiation and coordination of national adjustment policies in agriculture. There are many complex analytical questions which must be faced up to in the search for any international principles, guidelines, agreements, or understandings. Countries will continue, as they have in the past, to accuse each other of maintaining systems that provide greater protection, production incentives, and export aids. There can be no progress unless better measurements can be found for the economic impact of the various national policies. The EEC suggested the *montant de soutien* technique during the Kennedy Round, as a means of measuring the margin of support [2]. While this particular approach proved unworkable, there is a need to find some technique of quantifying the level of agricultural support and the degree of price distortion from one country to another and from one product to another.

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[1] The direct budget expenditures at all levels of government amounts to about $8 billion; the cost to consumers in prices above world levels, about $6-7 billion.

One interesting analytical question has come up in the context of proposals to limit or eliminate subsidies. Naturally, the question arises in debate among countries as to what levels to set for limiting subsidies, taking into account the effects of home production and marketing incentives. What is an efficient international price?[2]

Although there will be many who have difficulty with the idea, it will be necessary to examine in some detail whether some types of access commitments and price arrangements, or subsidy limits, are necessary, at least for a transitional period; and whether levy systems might be put under international discipline, and if so, how. Economists are badly needed to turn attention to these trade questions so as to lay the basis for sensible international discussion.

It is thus no longer sufficient to say that the international agricultural market will somehow take care of itself and that the best trade policy is one of minimum intervention. Governments have already committed their economic systems too far to allow abrupt adjustment to free trading principles. Given the present world technological adjustment problems, the seriously conflicting national policies, and the resurgence of mercantilism, there is urgent need for governments to intervene to restrain themselves and to restrain each other. At this time it is not a question of free trade based upon open commercial competition, because governments have so heavily intervened. So long as governments play such a dominant role, any solutions must be related to government actions, require government commitments, and provide meaningful international guidelines for governments to live by. Without some breakthrough of this character many countries will face extremely costly adjustment problems. For some countries, particularly the developing ones, there will be even broader implications for their economic development and political stability.

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[2] This question is even more complex when trade from eastern European nonmarket economies is considered, and the trade from these countries is increasingly important in world markets.

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New Concepts and Methods in Foreign Trade Negotiation

ROBERT B. SCHWENGER

I PARTICULARLY appreciate the opportunity to discuss foreign trade policy at this meeting of your Association. The subject is officially "open"—much as it was just 25 years ago when I wrote my first foreign trade paper for your Journal as a by-product of work on the team that drafted the GATT (General Agreement on Tariffs and Trade) [7]. The government and Congress are again looking for a new program. The record of hearings held and official recommendations made in the past two years runs to some 7000 pages, and the debate continues.

Summary

That debate is taking place against the conceptual background known as "free-trade-versus-protection" which has traditionally framed foreign trade thought in the United States. This paper contends that the conceptual system, however socially useful it may have been during the 19th century when the nation was developing and consolidating in a colonizing, warring world, is irrelevant today. It highlights the wrong questions about our foreign trade problems. Therefore, the negotiating method based on those concepts has been working in reverse. Although directed to reducing trade barriers, it increases them. Although dedicated to peace, it stirs up international hostility over trade matters—often over minor ones. Worst of all, it militates against efforts to work out an alternative method of international trade discussion on the basis of a more pertinent set of public concepts ready at hand for the purpose. I will argue that governments should now by-pass the free-trade-versus-protection concepts, which assume an essentially isolated static, laissez-faire national economy. Instead, they should be guided by the general concept of their collective responsibility for facilitating the prosperity of a dynamic world economy. In foreign-trade-policy terminology, that concept may be called "free-trade-versus-economic-fragmentation" or, more accurately, "free-trade-versus-Balkanization." It implies a mixed-economy, competitive-representative process for the world. One method for governments to work toward that kind of free trade would be through open joint deliberation of all facts relevant to a trade barrier, followed by public national reconsideration of the barrier with a view to eliminating it or modifying it to serve its purpose with minimum undesirable side effects, and then public consideration by other governments of cooperating toward that purpose. This approach would contribute not only to efficiency but also, by denationalizing trade conflict, to the building of positive economic peace.

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The Concept-Method Interface

As you can see from that summary, I take my assigned subject, "Concepts and Methods," to refer to concepts that pervade public debate and methods that governments formally announce. This takes us along a tortuous interface between science and art—that is, between social science theory and its application in governance. It is a tricky area for both theorist and official. It is especially dangerous for those who, like me, try to be dual purpose animals. Let me take a moment on this methodological point.

The role of the *social theorist* is threefold. First, he must perceive the real forces and trends that conduce to current social purpose as he reads that purpose (or, if he wishes to serve a group smaller than society, as his group reads it). Second, he must posit a model universe, incorporating as many as he can handle of the characteristics of the real world that are relevant to the purpose. Third, from his model, he must reason out concepts that can illumine for everyone the ways of accomplishing the purpose. The *policy official*, on his side, looks to the scientist's concepts for guidance in devising and support in making publicly acceptable methods of coping with real problems. Once publicly accepted, a concept, together with the assumptions built into it by its model, acquire a certain sanctity and resistance to change. Reality, on the other hand, changes rapidly. Different real characteristics become relevant and significant for social purpose; the model needs changing; the concept needs revision. The established scientist may be tempted to evade this challenge. He can say that his work is pure theory—or the exercise of, as your program so nicely puts it, the "tools of our trade"—leaving the real problems of society for the politicians and the general public. Or he may be tempted to patch up his model without retreating from his old policy conclusions. The official, of course, must go on dealing with the new problems, explaining his actions as modifications or exceptions to his announced method of acting.

At such times, the two may form a *defensive alliance*. Cooperation between social theorist and official is socially useful for assuring full public information regarding problems, policies, and proposals for change. But it can be a disservice if used to cover up the shortcomings of an out-dated model or, worse, to let such a model pass as the ideal to be achieved by a public program. Therefore, when re-examining the concepts behind a policy that is not functioning well, one must review the overall relationship of the science and the art, trying to avoid any subtext of unspoken values or assumptions.[1] To attack so broad a canvas in a half hour requires making assertions without sufficient qualification or demonstration. I hope we can share intuition—and allow reasonable benefit of doubt.

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[1] For pioneering studies of this problem, see [2, 3].

Present Concept and Method

To begin with, the economic *concept* behind U.S. foreign trade policy is free trade. It is expressed variously as freer trade, trade liberalization, reduction of trade barriers, withdrawal of intervention in trade, and so on. Withdrawing government intervention permits the expansion of mutually profitable trade. Then, by the operation of the mechanism of comparative international advantage, national resources are directed toward more efficient use. National income is increased. The sway of this concept over public policy in 1969 was evidenced by the general approval of opinion leaders when President Nixon said he was for freer trade.

But free trade is an "empty" concept—incomplete. It can be defined only in terms of something *not* done. Public power and public funds must not be used to check the flow of imports (or stimulate that of exports). Such government actions are called "protection" because they shelter or otherwise help domestic producers who must compete with foreigners. Free trade is zero protection. Free traders agree that if protection is withdrawn too rapidly or if there is substantial domestic unemployment or underemployment, the forces directing resources toward more efficient use may cause unusual suffering and loss. The domestic market for a product may be "disrupted." Some continued protection may, for a time, assure the most efficient resource use and the maximum national income. Also, some protection may be needed to develop a new industry. On the other hand, most public arguments for protection—whether or not logically consistent with the free trader's economic model—accept free trade as a desirable long-run goal. Although they differ as to which producers should be protected at a given time and for how long, free traders and protectionists make up a sort of community, contending publicly over common conceptual ground hallowed in U.S. history. When the President added to his freer-trade statement certain assurances of intervention to prevent disruptive foreign competition, the applause was widened—if not intensified.

There is one important *non-economic concept* usually associated with the free trade argument for our trade policy. Trade is mutually profitable. It strengthens the fabric of *international peace*. Government barriers to trade emphasize conflict of interests among nations and lead toward war. Removing trade barriers removes a cause of war; negotiating to reduce them reduces the danger of war.

The official *method* of reducing trade barriers is through *bargaining with foreign governments*. We tried tariff bargains from time to time through much of our history, but it was in 1934 that they became the core of our policy. The high 1930 tariff had helped deepen the depression. Other countries had retaliated in what proved a kind of reciprocal economic suicide. The world had learned that the trade purposes of almost any government act could be frustrated by a foreign counter act. Cordell Hull had the genius to forge a broad consensus of free traders and protectionists by reversing this. We would negotiate to get a foreign country to reduce its barriers to our exports in return for our reducing our barriers to imports. By selecting barriers on products imported principally from the other country, by negotiating with all countries, and by making each reduction applicable to imports from all countries, we would eventually reduce all barriers. The negotiations were held in secret. It was a sort of game; the participants pretended to bargain vigorously, but all were assumed to want the same final result. By moving cautiously and in a period of economic recovery, we minimized disruption. After the war, we were in a position to persuade all the large trading countries to join us in the GATT—with its "rounds" at which many pairs of countries bargain simultaneously under common general rules. There have been six rounds, from the seven-month "first Geneva" of 1947 to the almost interminable "Kennedy Round," which ended, technically at least, in 1967.

Left Behind by Changing Reality

The concepts and the method presented in that oversimplified sketch have made their great contribution. However, judged by their own value premises—efficiency and peace—they do not now serve a useful public purpose. The free-trade-versus-protection *concept* distracts public attention from the essential issues facing us because it conjures up a picture—a "model" if you please—in which three vital characteristics of today's world are not adequately incorporated. The three are the flowering of a world economy, the speeding up of dynamic growth, and the evolution of a competitive-representative, mixed-economy process. Let us consider each of these and how it brings the wrong questions to public attention.

A world economy

The free-trade-protection concept assumes a distinct national economy with a production process and income level essentially separate from those of other countries. The basic theory, comparative international advantage, deals with the effect of opening an isolated national economy to trade. The proof of the wisdom of opening trade is the more efficient use of national resources. (Proponents argue that foreign resources are also used more efficiently in most cases, but this is treated as of secondary importance if it does not follow automatically.)

In the early 19th century, when our free-trade-protection debate began, the separate-national-economy assumption had a substantial basis in fact. Moreover, we were a young, developing nation. The great powers were contending for colonies and discouraging the industrialization of new areas. Concepts based on the national-economy assumption bolstered those forces (toward national consolidation—against sectionalism) that far-seeing men then recognized as conducive to high social purpose.

In today's environment, however, it is most difficult to justify an economic model that posits a distinct national economy. The fact is that national economies are rapidly becoming interdependent parts of a world economy. Technological advance is daily stepping up the degree of their interpretation. Governments have more common interest than conflict in trade problems. Each national economy now achieves its greatest potential by functioning as part of a single world-production-consumption continuum. No national economy is viable when isolated, except in the rueful sense of being able to weather catastrophe. And, in the world of the superbombs, it would be difficult indeed to dispute that this common-economic-interest trend conduces to the self-interest and highest social purpose of any group one can conceivably serve—even weapons manufacturers, if they value posterity or their own lives. A foreign-trade-policy concept and method, to serve the national interest today, must assume a dependent, partial, national economy. (Incidentally, theorists could incorporate such an assumption into the static theory of international trade by simulating a complex world economy and then "wounding" it with controls introduced along an arbitrary geographic line within it. The implications of such an approach might be far-reaching for all international economic matters.[2])

Accelerated growth

The second shortcoming of the free-trade-protection conceptual system is its static base. It assumes a given "state of the arts." This is most strikingly manifest in a priori public concern with adjustment and with market shares, that is, anticipation of loss to a given domestic industry when foreigners expand their sales, even though the domestic industry is prospering. Taken together with the national-economy preconception, this produces some weird results. It is not unheard of for a domestic industry, which is the world leader in its product and which is booming, raising prices, investing in new plant, and advertising for more workers—it is not unheard of for such an industry to complain that it is losing a *share* of its market to imports and to get wide enough public sympathy so that Congress and the Administration put diplomatic pressure on foreign governments to restrain the imports. This, of course, is a rough description of the steel case in the United States—probably the textile case also. And most of the quota bills now in the Congress are designed to protect thriving industries from the anticipated trade consequences of world technological advance and growing American demand. Saddest of all, perhaps, is the poultry case where we and the EEC have managed to turn a technological breakthrough in the production of desperately needed animal protein into a full-scale economic war over a small, temporary trade shift due to the natural lag in the spread of the new technique. For a socially useful perspective on such world economic growing pains, one must take dynamic growth for granted. Innovation has become a way of life in much of industry and agriculture. We are, or soon will be, physically capable of producing enough to supply a decent minimum of necessaries to every human being; as we work at doing so, there will be demand enough to resolve almost any future trade problem. I understand that truly dynamic models—incorporating the unpredictable—elude scientists; perhaps concepts relevant to great change can not be derived from limited models. Nevertheless, intergovernmental discussion must conceive of trade as part of a world economy that is expanding rapidly and will expand ever more rapidly in the future.

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[2] This suggestion was originally made in [4].

The competitive-representative mixed economy

The third archaic assumption of the free-trade-protection concept is that trade within the national economy is already "free." If protection were removed, it is implied, laissez-faire would prevail, and the market would adjust the production-distribution pattern to a new equilibrium. In fact, of course, a mixed-economy, competitive-representative process has evolved within modern industrial countries. The production-distribution pattern is determined by the market power of a constantly shifting set of individuals, firms, associations, combinations, labor unions, community groups, clubs, societies, public corporations, "sub-governments" (as Douglas Cater dubbed them), and so on.[3] All of them compete, in a sense, for the custom and support of the paying and voting public. But all of them also try to influence government. And government intervenes as it considers necessary to modify the benefit pattern. It intervenes through subsidies, price supports, wage supports, transportation regulations, taxes of all sorts, social payments, procurement practices, administrative delays, prescribing standards, and innumerable other ways.

Now, government actions that influence domestic trade usually influence foreign trade also. (In fact, many of them are efforts to deal on a domestic policy basis with problems of the growth of the world economy.) Hence, they can be used to help domestic producers compete with foreign producers. They are protection under the accepted concept. The fashionable term for them is Non-Tariff Barriers (NTB's). Free trade means their discontinuance. The GATT rules require, in general, that those not discontinued be operated so as not to distort foreign trade. But the NTB's are constantly changing; they are thought of as determined primarily by domestic intervention purposes. Therefore, the GATT requirement is often ignored. A limited amount of reciprocal ignoring might not make too much difficulty. But governments that protest more and more foreign NTB's have had to submit to more and more official foreign criticism of their own domestic economic and social policies that affect trade. This creates misunderstandings and bitterness.

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[3] Cf. [1].

It is not really surprising, then, that *the method of bargaining trade barriers down,* publicly guided by a concept with such serious blind spots, *has contributed in recent years to putting barriers up.* Its harm may have begun to outweight its benefits as early as the mid-1950's, by which time, with some help from inflation, it had reduced most of the depression barriers to little more than nuisance levels. By the end of the Kennedy Round, the negotiations were bogged down in problems they had not been designed to solve. It was no longer clear what mutually valued common objective sustained the concert of bargaining nations. Each government tended to defend its own measures as being in the overriding national interest and to attack foreign measures as being unfair or illegal distortions of trade patterns. Cordell Hull's great consensus of free-traders and protectionists had fallen apart under these reciprocal attacks on measures traditionally considered domestic. The adversary, secret procedure of the little bargaining game had degenerated into bitter intergovernmental wrangling and public recrimination among high-level officials. That is where we are today in public posture. Governments, ostensibly seeking trade agreement, convey the impression that there is an economic basis for international hostility. The secret discussion format gives little occasion—and the accepted concept provides no rationale—for public deliberation as to which national measures affecting trade might be desirable or which not. Instead, the whole process appeals to emotional economic nationalism. It creates public support for the indiscriminate, "retaliatory" increase of trade barriers. This carries over to intransigence on other foreign economic, diplomatic, and even military issues. The trade-peace concept itself seems to work in reverse. Our negotiating method has a number of other disabilities, but these are probably the major ones [5].

Intergovernmental Cooperation—As Improvised Exception

Meanwhile, of course, officials go on living with the trade consequences of one another's intervention. When substantial real problems are created, governments usually come to an understanding in some way—formal agreement, tacit consent, or something intermediate—outside the intention of the free-trade concept and contrary to the rules of the bargaining game. Sometimes the intervention involved is a tolerated substitute for a trade barrier that has been bargained away. In the very first trade agreement completed under the Hull program in 1934, we cut the duty on our largest competitive agricultural import—sugar—a full 50 percent; but, at the same time, we put on a system of variable import controls to support the U.S. price, giving foreign suppliers some benefits also. Trade policy officials boast of the large duty reduction, but they wink at the absolute government control of the trade. At other times there is accommodation and positive coordination of intervention. My 1945 Journal article reported a plan to make an exception from the bargaining rules for certain crop programs, provided there was agreement on intergovernmental coordination looking toward a comparative-international-advantage production pattern [7]. When I reported at your 1957 Christmas meetings on the clauses of the GATT incorporating this exception [6], I had trouble getting my paper cleared for publication because that part of the GATT was being flouted by the United States. In the name of free trade, we were discouraging any intergovernmental commodity discussion whatever. But reality soon changed that. A PL 480 market-study team in Brazil that year discovered that trees already planted would shortly be bearing twice as much coffee as the world could consume, and planting was continuing. Important Latin-American economies were threatened. We began actively to promote the coffee agreement that we had been actively opposing. In one way or another governments have coordinated their intervention, as exceptions to the trade-freeing rules, to prevent extreme prices for a number of primary products, to block non-essential imports into redeveloping Europe, to move industrial-country food surpluses to hungry people in poor countries, to prevent dissipation of less-developed-country foreign exchange on luxuries, to limit the rapidity of trade increases considered disruptive, and to do many other things—small and great, narrow and broad—that the free market would not do but that governments considered necessary. Some conspicuous current cases are the arrangements for restraint of exports of meats, textiles, and steel. President Nixon's assurance regarding market disruption referred to this type of arrangement.

Guidance and Public Surveillance Needed

The successes and the failures of these efforts to solve problems through coordinated action point the way to the general concepts and formal methods needed today. Five points may be of special note. First, great good has often been done. Second, there has been abuse of both political power and secrecy. Third, there has been wider understanding and lessened intergovernmental conflict over the specific problems involved. Fourth, the GATT surveillance through the secret review of periodic reports has not been very effective. Fifth, the irrelevance of the free-trade concept for coordinated action and the lack of general agreement on any relevant concept have, on the one hand, facilitated abuses and, on the other, given an aimless, ineffectual quality to much that governments should have done proudly.

Proposed Concept: Collective Responsibility

Fortunately, a relevant and familiar public concept is ready at hand for governments to use. If one pictures a growing, integrating world economy, one is struck by the collective responsibility of governments to represent the interest of all people in its effective working. Moreover, one can see that, for that responsibility to be discharged well, something resembling the representative-competitive, mixed-economy, political-social process is needed at the international level. As a matter of fact, many of the components have been forming slowly for years [5]. All sorts of individuals and groups have international connections. The management and finance components have recently been developing quite rapidly. In fact, there is serious concern that they may outgrow governments. In the non-trade-policy areas—such as monetary management and the maintenance of business activity and employment—governments have been recognizing their mutual dependence through cooperative action. But in the trade field, the non-intervention concept and the adversary method undermine their own adaptations to reality. They hobble cooperation.

Proposed conceptual system: free trade versus Balkanization

Interestingly enough, the collective-responsibility concept applied to the trade field immediately suggests free trade. In fact, for many non-technical people, the common-sense meaning of free trade implies collective responsibility. You have all heard the popular dictum: The United States became the world's leading industrial country because we had free trade from ocean to ocean while Europe was cut up by national tariff walls. Unfortunately, experts and officials often take this public theory as support for their entrenched concept and method. But consider the implications of it! In the socio-economic process that it implies, trade is not free from government intervention—not at all! It is subject to all sorts of surveillance and interference in the public interest. In our great ocean-to-ocean free-trade area, government is *expected* to intervene to affect trade in connection with the supply of public necessities, natural monopoly, misrepresentation, private restraints on trade, public health, public morals, large crop surpluses, exploitation of workers, cutthroat pricing, excessive market power, and anything a majority of the people want it to affect. What it must *not* do is interefere with the movement of trade across fixed geographic lines within the economy. It must *not* allow us to be carved up into state economies or regional economies. This is the foreign-trade freedom that would advance national interest within an up-to-date world economic model. This trade freedom is not defined as the absence of protection, i.e., the absence of intervention affecting trade. It is defined as the absence of such intervention applied along arbitrary geographic lines. It is freedom from economic fragmentation—or, as it used to be called, Balkanization.

The deliberating method—eliminate intervention or coordinate it

With these concepts in mind, one can see the direction sovereign governments must explore to discharge their collective responsibility for letting trade flow freely and for intervening as cooperatively as possible when the public interest requires it. The general procedure I would propose that they try involves three elements: deliberation, decision, and coordination. Governments would agree to a continuing multilateral forum for deliberation—open for the public to hear and to be heard. A controversial government action affecting trade would be discussed in the light of its announced purpose. The object of the deliberation would be a factual report on all of the economic effects of the action—domestic and foreign, direct and indirect, concentrated and diffused, immediate and longer term, costs and gains. Facts regarding actions of other governments affecting the same trade problem could be included. As far as possible, these matters would be quantified. (Here is work aplenty for dedicated economists.) There would be no façade of multilateral decision to be struggled for and then ignored. Hence, there would be no national positions decided secretly in advance of the discussion. Decision would be left to the acting government, committed to subsequent reconsideration of its action—through its own constitutional processes, but in public—with a view to (a) discontinuing an action it found no longer desirable and (b) framing any further action needed for the originally announced purpose in such a way that it can be accomplished with a minimum of adverse side-effect on the world economy, its own citizens, and citizens of other countries. All governments would be committed to consider cooperation toward accomplishing the public purpose of an action announced after such national reconsideration. This would initiate a process of informal public communication, coordination, and, as necessary, agreement regarding the original problem.

There would be an independent International Trade-Fact Authority responsible to legislatures—not to governments. It would consist of national Trade-Fact officers whose only responsibility would be to assure that both the international discussion and the subsequent domestic reconsideration were as fully informed as possible. They would have the necessary authority to know and to disclose facts (but not to counsel or take action). Thus, any action affecting trade would be informed and would be publicly understood in its relation to available alternatives.

Some Elaborating Assertions

That is the proposal. The details, of course, will not be easy to work out. I discussed a few of them in the J.E.C. paper mentioned earlier [5]. Let me conclude with a few assertions:

(1) Unlike the bargaining method of foreign-trade negotiation, the deliberating method would reinforce other U.S. policy. Thus, it would en-

courage intergovernmental coordination of necessary farm supports, instead of abetting economic warfare over them. It would facilitate cooperation to use the world's basic-food production capacity to feed the world's hungry. It would lead to the mutual understanding of one another's intervention needs that is required if industrial countries are to join purposively in the trade arrangements needed to speed the development programs of poorer countries. It might focus intergovernmental consideration of problems related to multi-national firms without inhibiting their imporant contribution to growth. It would remove an ideological and prestige problem from trade discussion with state-ownership countries. In short, it would make overall foreign economic policy more coherent.

(2) Functionally, the most important part of the proposal is the independent International Trade-Fact Authority. Unless one has participated in trade negotiations, it is difficult to imagine the enormity of the role played by misinformation, misunderstanding, and unrecognized ignorance. Problems become conflicts before common solutions are sought. With a citizenry informed by modern communication and expecting to see the social benefits of technology realized, public authority must support institutions for assuring the full availability of relevant facts and a public sense of involvement in solving trade problems. Only thus can there be the eternal democratic vigilance needed to maintain dynamic balance in the mixed-economy process.

(3) Last April, Secretary Stans proposed "open table" discussions of NTB's. This may be intended as a step toward non-adversary deliberation. Unfortunately, he simultaneously demanded quotas to "protect" a thriving American industry; he threatened indiscriminate protectionism rather than wait for open deliberation of the need for quotas. Is our policy the cooperative new approach or the pugnacious old one? I believe that it would help in this, and in all efforts toward economic peace, if political economists were to promulgate such concepts as free-trade-versus-Balkanization and collective-responsibility-for-the-world-economy.

(4) The greatest benefit from open deliberation would be the "degeographicalizing" or "denationalizing" of economic conflict—and the associated recognition of what I call the "ethic of economic agreement." Governments would not, as now, face one another as surrogate competitors. They would be committed to public joint weighing of all the information relative to a given trade barrier, including that regarding their own interest in changing their own action. The format of discussion would highlight the obligation, for the common good, to carry economic discussion to the point of full, reciprocal understanding, and not to let it break off into political power conflict among sovereigns. Against the fragmenting "multi-polarity" (to use Kissinger's term for it) of the world's sovereign-state political system, it would help bring to bear the real unity—the "uni-po-

liarity" if you please—of the world's integrating economic environment. Institutions which can do that are necessary foundation stones in any enduring structure of world peace.

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Discussion: Policy and Non-Policy in Foreign Trade

JAMES G. KENDRICK

Malmgren and Schlechty have provided us with a detailed and far-reaching examination of the futility of trade restraint escalation. Their papers adds to the growing volume of current writings that are focusing upon the rising protectionist mood found both here and abroad.

Economists seem most flusterated when the political-economic real world ignores basic doctrine; and the free trade concept is as basic a doctrine as one can find. When an economist delves into his carefully acquired theoretical tool kit, he finds no instrument that will force an automatic return to the normative free trade model once trade restraints are employed as a major operational strategy among the major trading nations in the world. Unfortunately, as all of us have been forced painfully to learn, the real world does not operate entirely within the confines of economic logic. Many of our concepts of the theoretical operations of market economies are, in fact, based upon a whole set of political and social assumptions that can be both local and temporary.

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This observation concerning the lack of universality of models is neither original nor new, of course. In the early 1800's, Frederick List was documenting that free trade among nations would yield results only when that trade was among nations of similar economic and social conditions. Since most of our theoretical heritage is based upon static or comparatively static conditions, further troubles confront the economist when the real world adds the complicating parameter of dynamics.

I thus find an unfortunate emphasis in the Malmgren and Schlechty paper that might lead the casual reader to conclude that technology was the cause of rising protectionism in international trade and that negotiations among the nations might logically take the form of offsetting the effects of that technology. Certainly technology has increased the economic pressure for adjustments in resource location and use, which would then alter trade patterns. However, I am reluctant to place technology in the villain's role, for technology may be only a by-product of generally dynamic conditions.

I would also respectfully differ with Malmgren and Schlechty in their suggested approach to reduce these barriers. They rightly suggest that there is a need for coordination of national policies among the trading nations, but coordinated or not, national trade policies that are fundamentally designed to offset technological advances do not always advance the welfare of the entire population of those nations who have engaged in commercial trade.

Would it be heresy to suggest that most of the agricultural trade policies of the world are based upon an implicit assumption that suggests each nation will support a redundancy of resources in the agricultural sector by generating maintenance incomes for those resources through manipulated market mechanisms. In a static setting, this philosophy might prove desirable. It is both logical and natural to desire protection for agricultural incomes through trade restraints, if one assumes that low resource earnings are only temporary. But given dynamic conditions and some degree of resource fixity, the judgment of the market place concerning factor payments will not infallibly move an economy smoothly toward needed adjustments. Confronted with dynamics, at least two courses of action are possible:

(1) Establish trade restraints that to some degree negate the need for resource adjustment, or

(2) Use public monies exogenous to the market mechanism in an attempt to support resource earnings while adjustments in resource use are taking place.

The first strategy might be employed either when the situation is deemed static or when there is a reluctance to interface the agricultural and non-agricultural sectors of an economy. The second strategy might be desirable if low resource earnings were, in part, caused by dynamic conditions and the overall economic objective of the economy was to maximize aggregate welfare rather than that of an economic sub-sector.

We may be closer to general acceptance of the latter strategy than we might imagine. A Republican President has suggested direct supplementary payments for low income families. The stated objective of the President's policy was to maintain incomes outside the market place while human resource mobility was being increased through job retraining.

The current agricultural negotiation position of the United States might be capable of alteration if this nation adopted a meaningful program of sub-sector readjustment, implemented through enhanced labor mobility and achieved by way of large-scale retraining efforts supplemented by income assistance payments. Should the EFTA and EEC nations continue their policy of subsidizing agricultural exports, these products could be imported and used by the United States as complementary to the readjustment process. Still assuming a meaningful program on the part of our government to aid and speed inter-sector adjustments, our agricultural negotiators would then be less pressured to find foreign outlets for United States agricultural products.

I concur with the position that there is a natural tendency for each nation to attempt to countervail the actions of others when changes in trade barriers occur. In this case, however, we are encouraging subsidized agricultural exports by others so that we might receive an income transfer effect. It might be hypothesized that if other nations attempt to countervail this philosophy, the resulting mutual escalations would lead to a general lowering of the trade barrier profile.

The preceding may seem quite a fanciful treatment of the admittedly serious issue raised in the Malmgren-Schlechty paper—the steady increase in trade barriers. My remarks are intended to reflect upon the inherent conflict between problems caused by dynamic conditions and solution strategies based upon static doctrines.

Discussion: Policy and Non-Policy in Foreign Trade

G. A. MacEachern and B. Huff

The two papers are complementary. They focus on the essence of the problem—how to maintain the thrust and momentum of post-war policy leading to an increase in the international flow of goods, particularly agricultural products, within the framework of a reemerging feudalism.

Malmgren and Schlechty say international trading is bad now and is going to get worse. A new tool is needed to remedy the situation quickly. Schwenger has something substantial to offer but it may not be quick. Furthermore, changes will be required, especially on the part of negotiators, if negotiators are needed at all. Nevertheless, the suggestion deserves serious attention, early acceptance, and application.

There are a few comments one could make on specific points or degree of emphasis that reflect perspective from another trading country. However, the important point is the implications to agricultural economists and research of what is being suggested to improve agricultural trade.

Three major points are evident: (1) agriculture has been and will probably continue to be the most difficult stumbling block in efforts to liberalize international trade, so that any progress achieved will have externalities. (2) There are numerous inter- and intra-national problems associated with improved agricultural trade. Many are pervasive and outside agriculture per se. But there appears to be general agreement on the need for better information, more discussion, and new institutions concerned with trade. The Schwenger approach becomes more meaningful viewed from such an angle. (3) Our present state may be indicative of both the lack of intensity and irrelevance of research on agricultural trade problems or of the ineffectiveness of communicating known information to the public in general and particularly to those participating in international negotiation.

Schwenger's critical comments on trade theory appear to be more applicable to the negotiating aspect. This may be due to voids in research application, adaption to present realities, and the important trade questions, rather than to the relevance of the existing stock of trade and other economic principles. Trade theory has advanced considerably since the days of Smith and Ricardo. There are sophisticated theories and models that can handle dynamics, interdependence, space, and institutional restraints. However there are few examples where these have been used to provide

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meaningful tools to negotiators. At least commodity interrelationships can be handled conceptually and empirically. But commodity bargaining is still carried on as though separate islands exist.

The key to proper functioning of the International Trade Fact Authority proposed for better understanding and deliberations among governments and with the public is an improved research and information effort not only in the trade area but in domestic policy as well. Despite the availability of useful tools, there has been little application to the many important trade questions. For example, it is possible to construct global models although not incorporating all the complexities that may exist. These would be useful in analyzing the effects of trade policy changes. At least, commodity and area interrelationships can be specified to determine sensitivity to changes and direction of adjustments from trade and subsidy program alterations, without necessarily estimating the distribution of benefits and costs of the change. The converse to this has been the use of cruder estimates giving almost exclusive attention to producer interest, a need for greater experimentation, and perhaps reluctance to negotiate seriously. The minimum requirements for global trade improvements are far from being achieved. The limited attention given agricultural trade matters in research has largely focused on tariffs and, to a limited extent, on subsidies; although there are other equal or more important restraints, e.g., tax laws, patents, different legislation among countries, "multi-national" corporation trading and pricing policies, indirect tax systems, "restraint arrangements," etc.

Much needs to be done even though globally the matrices are large and befuddled and the estimates crude. Perhaps it follows that with smaller, more manageable matrices there would be better analysis and understanding of the impact from policy change. The open-deliberation concept as opposed to bargaining may have immediate application to smaller matrices, while new initiatives suggested by Schwenger are applied globally to obtain steady improvement. International wheat problems, the Common Agricultural Policy, global discussion of farm subsidy programs, and other key areas mentioned by Malmgren and Schlechty come to mind.

Does the knowledge limit on the effects of trade policy changes have anything to do with the growth of economic regionalism or custom unions? Would it make any sense (if we in North America are serious about expanding agricultural trade over the long pull) to demonstrate our sincere interest by seriously investigating the impact of removing at least some restrictions, moving toward a more compatible continental agricultural industry, demonstrating to others how this can be accomplished without damaging effects on other countries while pushing an open-deliberation policy globally. Even with GATT commitments there is plenty of leeway for improvements to be made.

Malmgren and Schlechty may be able to realize benefits quickly by applying the open-deliberation concept immediately on a variety of fronts and still exert global pressures while not having to wait for complete "degeographicalizing."

Would this be a more useful strategy in easing conflict and enhancing hopes for trade expansion? Would this make much more sense than stepping up cost pressures on other countries including the U.S. economy through subsidy retaliation now practiced and about to be intensified?

Discussion: Policy and Non-Policy in Foreign Trade

RICHARD J. GOODMAN

Both Schwenger and Malmgren tell us generally, in somewhat different ways, that the Kennedy Round was a failure. With that I agree. Malmgren is considerably more cautious in referring to the value of the outcome, and then clearly only with reference to agriculture. I have only a few remarks on his paper.

He tells us quite well, commodity by commodity, how bad agricultural trade protection has become, particularly in the EEC, but also in the United States, the United Kingdom, other Western Europe countries, Latin America, etc. He also fingers for us the particular vehicles upon which protectionism has been riding, e.g., the EEC's CAP, other minimum import pricing policies, import quotas to protect farm income schemes, and extra preferential trade arrangements. He then points out to us possible further problems arising out of additional economic regionalism and the international transmission of technology.

Malmgren comes finally to the resulting problems of international adjustment. But he discusses these problems in terms of quantities of commodities, mounting surpluses, and historically strange inter-commodity patterns of trade, observing that all of this costs a great deal of money, particularly in the EEC and, by almost offhanded incidence, that very high guaranteed and administered prices are of course involved. This is where frustration sets in.

The problem described stems, as Malmgren mentions, from resource misallocation. The absolute and relative levels of guaranteed and protected commodity prices directs the resource misallocation. These administered price levels are a result of income policies for agriculture that specify that prices be fixed to meet income goals within a given or assumed agricultural structure. So, what will be needed first of all, in Malm-

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gren's call for coordination of national agricultural adjustment policies, is a confrontation among agricultural trading nations over the future structual form and social significance of farming, at least in the industrialized world. After all, what is sought in coordination is harmonization. To harmonize policies of unstated long-run economic, social, or political objectives may not only be intellectually difficult, it might also be counterproductive to trade liberalization.

Schwenger's key points are (1) that the "free trade-versus-protection" concept of past GATT negotiations is obsolete and should be replaced by a "free trade-versus-economic fragmentation" concept; and (2) that the methodology of the traditional "round" of secret negotiations be converted into a continuous, fully public, multilateral deliberation. He contends that the present concept does not apply because it assumes isolated, static, laissez-faire national economies. All of this I believe I can agree with. However, he goes on to knock the single concept of free trade as "empty," "incomplete," and "defined only in terms of something not done." Free trade is used as the leading edge in identifying the obsolete concept (free trade-versus-protection), but it is also used as the leading edge in identifying the proposed new concept (free trade-versus-economic fragmentation). I have had to assume that what Schwenger has in mind, in a theoretical sense, is that the single concept of free trade is useful only when accompanied by a realistic view of the economic world as integrated, interdependent, dynamic, growing, and governmentally administered.

Running in this sort of company, the single concept of free trade is not empty, can be complete, and may be defined in things to do, that is, of positive rather than negative meaning. If this is an accurate interpretation of Schwenger's conceptual layout, it is fine. Where does he then lead us? He makes a point about traditional trade bargaining under the old concept that I suspect few people have come to fully appreciate. It is that at least the last two GATT "rounds" have increased trade barriers rather than decreased them. This has come about through the replacement of regular tariffs, reduced in the bargaining process, by non-tariff barriers not included in the bargaining process. The tariffs that were reduced had been substantially less trade restrictive even before they were reduced than the quotas, taxes, variable levies, and trading preferences that were added. So, I agree with Schwenger's point that trade policy concepts and negotiating methods of recent use have not worked. Of course, some new approach must be sought.

Schwenger suggests a new policy concept, which he finally describes as collective responsibility, defined as not precluding government intervention, not even for protective purposes, but only precluding intervention "applied along arbitrary geographic lines." Freedom of movement of trade, of course, completely precludes certain types of protection, and partially so others. But, the important and more interesting suggestions he makes are not conceptual, no matter how vague or high flying one might like such suggestions to be. Rather, it is his suggestions on method that have more immediate relevance. Open continuous deliberation supported and disciplined by full, clear, honest, independent information has obvious great appeal. It should have a better chance of working productively than any modified continuation of the old "round" method. One of the benefits could be the exposure of personal political interests, self-seeking prestigious aggrandizement, and paranoic personality problems among members, including leaders of national trade delegations. It could also be virtually the only way to bring about the productive confrontation of long-run economic, social, and political objectives for farming among the agricultural trading countries that I mentioned in connection with Malmgren's paper as being of beginning necessity in tackling growing agricultural trade protectionism.

CONTENT AND TECHNIQUE IN EDUCATION ON POLICY

CHAIRMAN: J. CARROLL BOTTUM, PURDUE UNIVERSITY

A Basic Framework for Policy Education

J. B. KOHLMEYER

THIS paper was prepared for educators primarily concerned with the development of an informal adult educational program in public policy.

The framework is designed from an educational operations point of view: What do you teach, who do you teach, how do you teach, and how well do you teach? I have tried to erect a sort of categorical scaffolding that makes it easier to pinpoint some of the elements that might well be included. I have tried to put these into nice, neat, little boxes. In actual practice, things are not that simple.

The framework submitted for your consideration, should be looked upon as an alternative framework. You well know that an educator tends to employ methods that fit his endowments. This framework reflects my observations and experiences over a period of years. The biases and prejudices that have crept in are those of an educator who has enjoyed operating in the public policy making arena for a number of years.

A Suggested Categorical Framework

1. *Specialize in an area. Then zero in on a problem that is identifiable; one that is small enough to be manageable; one that the public is going to do something about in the not too distant future. This problem may be of local, state, regional, national, or international concern.*

Timing is extremely important. Leftover Christmas trees are hard to sell on the 26th day of December. Straw hats do not adorn the haberdasher's shelves in December. Remember, when it comes to informal adult education, participation is voluntary. You simply cannot do any educating without pupils.

How can you tell what is going to be timely? How do you know what problems are going to be a matter of public concern? There are many different ways of course; I will direct your attention to only two:

(a) Keep your eyes and ears open. A policy educator must of necessity have a high listening I.Q. Travel, move around, read, talk to people. As

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you travel throughout the state pick up local newspapers. Ask your country agents what problems appear to be a matter of public concern to the local leaders of his county. Live in the world of reality; know what is going on. Find out what's on your barber's mind.

Why do so many people ask what is Secretary of Agriculture Hardin going to do? Why did President Nixon propose a revamping of the welfare program?

(b) Apply outlook. Changing conditions give rise to problems. By 1949, it was obvious that school district reorganization would soon be imminent in the midwest. The mechanization of agriculture, which led to a decline in the rural population, indicated something would have to be done to get kids together in bigger bunches in the not too distant future.

By September of 1968 it was obvious that many of the elementary and secondary schools of Indiana would not be able to operate by 1970 unless the 1969 General Assembly revamped the method of financing. It did.

Well, if an educator has to keep up with what is going on as well as what is likely to be of concern in a year or so, he is forced to specialize in certain problem areas.

How many of you can tell me when the first crop of colts sired by either Bret Hanover or Noble Victory will be offered for sale?

Did you ever go to the grocery store and find out after you got there that your wife had forgotten to give you the list. The only place you could find anything with the label groceries on it was a sign on the wall. If you wanted to buy anything, it was a matter of salt, pepper, vinegar, etc. So it is with public problems. There is no such thing as the Health Problem, the Farm Problem, or the School Problem. Instead, there is a whole series of little problems. A little problem like what ought to be done about the trash and garbage that is being dumped in the alleys and scattered along the country side? If you want to know where to take hold, all you have to do is decide how you are going to collect it; how you are going to dispose of it, and how you are going to finance the job. From a problem-solving standpoint, we complicate things by putting cancer research and vaccinating dogs for rabies in the same package.

Instead of the School Problem, we find myriad little problems, ranging all the way from how money ought to be raised to pay teachers to how Johnny ought to cut his hair.

Here again, as a problem solver, you complicate things by putting them into the same package.

2. *"Tool Up." Get ready to do some informal adult teaching. Become an expert as far as a particular problem is concerned. Learn to know something about the individuals you are going to teach, their knowledge of the problem, their values, etc. "Be creative," invent some new solutions. Put the problem in a decision-making framework.*

In this endeavor your economic training will serve you well. But you will find it to be inadequate in and by itself. When you work on a public policy problem, you will find there are no purely economic problems. There are only problems with economic aspects. You will have to know something about the other aspects to fit the economics into its proper perspective. So with economic knowledge alone, you are in about the same position as a fisherman with a pole, but no hook or line.

Let me illustrate by relating one of my early experiences.

Years ago, one of our top county agents asked me to come to his county to discuss School Problems, and what the people could do to improve their schools. I assembled a lot of data, which was presented in standard extension specialist style. During the question and answer period, I was unable to answer many of the questions asked. The next morning, while we were having breakfast together, the county agent lowered the boom. His comment:

"Mostly bones, very little meat; you did a wonderful job describing the present situation and explaining Chapter 123, Acts of 1947. That information about enrollments, per capita costs, pupil-teacher ratios, etc., was interesting, but at this stage of the game it was not relevant. And as far as that Chapter 123, Acts of 1947, was concerned, they didn't care whether it was Chapter 123, 223, or 333, or whether it was passed in 1937 or 1947. What they wanted to know was whether to put 2, 3, 4, or 5 high schools together and the advantages and disadvantages of so doing. What they want for their high school pupils is four years of math, four years of English, four years of science, etc. They want their youngsters to be able to compete. How big does a school have to be to provide it? Now, when you get that kind of information together, let me know, and I'll see if I can get that bunch together again."

You see, my trouble was that I didn't know enough about schools. At that time most of the secondary information available about our elementary and secondary schools was interesting but not relevant for the problem at hand. Well, I never got caught with my pants down on that question again, but it took a while to dig up the answer. He never did get that bunch together again. Time and time again you never get a second chance. You know, there is such a thing as a teachable moment.

As you seek solutions for problems, you will find on numerous occasions that the means for accomplishing certain ends are inadequate, too complicated or cumbersome, and someone has to come up with an entirely new idea—an invention, if you please. Just as inventions supply the wares of economic change, so must inventions supply the wares of social change. Inventions advance the state of the arts, make new technology possible, and provide the individual and our society with a new range of choices.

Another thing that has impressed me over the years is *how little infor-*

mation is needed if it is the right kind and how much that I thought would be important is of little concern. You need to know what a lot of people regard as gospel truth, but "ain't so," and then set up a learning situation that enables the learner to discover it on his own.

After all, what you are trying to do is to provide the learner with an experience that will broaden his knowledge and understanding about the problem—the choices available to him, the probable consequences of each choice—thereby providing him with a broader basis for decision making. You can't make policy without making some decisions.

3. *Make plans to provide a learning experience for individuals vitally interested in finding an acceptable solution for a particular problem.*

As the Extension Service, of which we are a part, is organized, it is difficult to operate without a booking agent. It is at the local level that decisions are made about what is to be taught, who is to teach it, and who is to be taught.

The provision of a staisfactory learning experience takes a lot of preplanning. Actually, if well done, this is a joint undertaking of area administrators, local agents, and the specialist.

For illustration purposes, I would like to recite a recent experience. Earlier in the paper, mention was made of an impending school finance problem. There was wide-spread confusion about the present situation and probable future developments, as well as about what might be done. The likely governor-elect was running on a no-new-state-tax program. Local school districts were confronted with local tax rate limitations. The General Assembly would convene in early January 1969.

The desirability of providing a learning experience in this problem area was first discussed with the area administrators. They were aware of the fact that this problem was a matter of public concern, and they put consideration of the problem on a high priority list. Next, how do we get in gear? After we had given consideration to preferable dates, how to secure attendance, who was to be invited, kinds of subject matter material to be offered, etc., the area administrators agreed to take over, provided I would prepare a memo to be sent to each agent. It was tentatively decided to have a dinner meeting in each area, shoot for an attendance of 75 to 100, get acquainted 5:30 to 6:00, dinner 6:00 to 7:00, adjournment by 9:00 p.m. Why dinner meetings? It is easier to get attendance.

In a week or so the phones began to ring; some of the area agents insisted that they needed to have more firsthand information about what we expected to accomplish, etc.

Five or six conferences were arranged. Calendars of agents and area administrators were too cluttered to arrange them in all areas. (Fortunately, this gave us some check plots.) One of the first questions raised by the agents: If we make reservations for 100 and only 50 show up, who picks up the tab? We discussed at considerable length just who was to be invited. Believe it or not, each county was given a quota (example: 8–12); no open invitations; tickets were to be sold in advance. On the whole, this intensive pre-planning paid off. A typical cross section attendance consisted of:

20–25	school board members—not more than 2 or 3 from each school district
20–25	business and professional people
15–20	farmers
2–5	legislators
15–25	other

We hoped to be able to attract individuals who were concerned with finding a satisfactory solution for the problem and who, once having decided what ought to be done, knew what steps to take to get it done.

You might be interested in knowing the comments of the legislators. In substance they were about like this: "Unusual experience to be invited to a meeting where someone didn't try to brain-wash you." "If more meetings like this were held over the state, the life of a legislator would be easier."

Newspaper men are still trying to find out what that expert from Purdue University really thought ought to be done.

4. *Provide a satisfactory learning experience for the individuals participating in this particular activity.*

The individuals you expect to attract to your meeting, conference, seminar, or whatever you choose to call it, are busy; their time is valuable. If they do not have a satisfactory learning experience, the news will travel. The next morning, if not yet that night, everyone in attendance will be asked by one of his peers, what went on last night, did you learn anything or was it a waste of time, etc. If they reply, "I wouldn't have missed it for anything, you should have been there, I learned a few things I never knew before," you are in business. But if they say, "I wish I had stayed at home," you are in trouble. If you do a good job, your booking agents will perk up, and you are on the road to developing a clientele, for public policy education, for the Extension Service, for your university, and, last but not least, for yourself.

Years ago, one of my teachers once commented, "Subject matter without method can be boring, method without subject matter content is sterile." Now what are some of the things that you need to do? This may be the first time this particular group has ever been together. They are a diverse lot; things are tense. It's not like the meeting where everyone there was a banker or a Ford dealer or a Farm Bureau member, or an Elk.

Well, you need an ice-breaker of some kind, an attention getter. A disarming device. Make everyone feel welcome and at home, and let him know that policy education is different. Stimulate discussion, cast yourself in the role of a discussion leader and wipe out that college professor image, watch your vocabulary, get to the crucial points fast. Bore in on the one, two, or three "key points." Substitute facts for what they think are facts but are not.

In those school finance meetings I placed high on the agenda, "Dispel some misconception of 25 years standing about the consequences of low and high qualifying rates and low and high foundation programs."

Qualifying rate is a legal term which established the minimum local tax rate that must be levied to be eligible for state aid. Foundation program is another legal term, similar to what farmers call support prices. In other words, the state says we will support your school costs up to X dollars per pupil and pay you the difference between the support price and the amount raised by the qualifying rate.

Well, every text book I have ever seen on school finance says the qualifying rate should be low enough to give the local school district enough elbow room so that they can levy a tax higher than the qualifying rate. What the authors forgot to say was that additional elbow room in a peach tree with no peaches on it simply won't put any more peaches in the basket. School administration in school districts with very little wealth per pupil have fought for years to keep the qualifying rate low.

All we did was set up a sixth grade arithmetic problem and worked it out together on the blackboard to see how it came out.

A low qualifying rate in itself makes poor people poorer. It permits the wealthy to get under the state aid umbrella, which means that you run out of money in a hurry.

I have yet to find an occasion where the application of sixth grade arithmetic wasn't all the math you needed. The Russians say all you need to know is to be able to multiply and divide by 2. You do not need to know anything about fractions.

Get down to alternative solutions and consequences in a hurry because that is the "meat." Then give them a chance to exchange ideas with each other. You know this is fun—involvement learning something you didn't know before, getting the cobwebs out of your brain, without being told you were dumb, etc.

5. *Be willing to provide technical assistance when needed.*

Making a decision about what ought to be done is just one step in the policy-making process. The next step is putting legs on the decision.

Often this will require a new law, or an amendment to an existing law, or the preparation of an ordinance or the like.

Sometimes they need help, and you may be able to tell them where to get it or you may do it yourself. I have either written or helped write over 50 bills that have been introduced to the General Assembly. A lawyer can't do it alone; before he can write, he must know precisely what you want to accomplish and what procedural steps you would like to follow to do it.

6. *Give your clientele an opportunity to tell you what they think of it. Ask them to grade the teacher.*

Our former Dean and Director, H. J. Reed, used to tell his extension workers:

"Extension teaching and college class room teaching are different. Here at the university, the professor flunks the pupils; in Extension the pupils flunk the teacher."

All of us have seen rating scales. I remember one I once filled out at one of our neighboring midwest institutions; on reverse side of the sheet, I wrote something like this: "On your rating sheet, you failed to ask the right questions; you should have left a place for remarks. My remarks are as follows: Unless the kind of learning experience you provide is radically revised next year, I am going to advise every individual in the United States I know who might attend to stay home." It was radically revised.

I have not developed a rating sheet; but, now that I have retired, I am working on one. I need help. As a starting point, the one used by G. H. Wheatley at the National Science Foundation Summer Institute at Purdue University includes some criteria that might be helpful. Without too much trouble, we can make some appropriate deletions and/or additions.

Let me read some of it to you.

Course and Instructor Rating Form

On the following pages you will find a list describing various characteristics of college instructors. Please rate the primary instructor (lecturer) of the class in which you received this questionnaire on each of these characteristics. Using the scale shown below, write the number corresponding to your answer in the space provided to the right of each question. (i.e., you are to answer on the questionnaire itself)

1 ________	2 ________	3 ________	4 ________	5 ________	6 ________	7 ________
completely unsatisfactory	poor	adequate	good	very good	superior	Na (not applicable)

IMPORTANT!

You may remove this instruction sheet for easy reference to the scale. DO NOT detach any of the other pages. PLEASE!

1. Formal or textbook knowledge of the subject matter ______
2. Personal knowledge or experience with subject matter as demonstrated in lectures, labs, etc. ______
3. *Ability* to answer students' questions about the subject matter satisfactorily ______
4. "Up-to-date-ness" of the material presented ______
5. Interest and enthusiasm for the subject matter ______
6. Is concise in his presentation (does not use too many words or repeat unnecessarily) ______
7. Adapts to the class' level of vocabulary and understanding ______
8. Presents his ideas clearly (unambiguously) ______
9. Gets his material across to the students (communicates his knowledge) ______
10. Generally makes a subject seem interesting to the student (entertaining) ______
11. Stimulates interest in a topic (makes students want to study and learn more about it) ______
12. Challenges the students to think and work things out for themselves ______
13. Loud and distinct speaking voice ______
14. Appropriate rate of speaking—not too fast or too slow ______
15. Legible blackboard writing or printing ______
16. Makes expectations about performance and policies (grades, attendance, etc.) known early in the term ______
17. Is punctual beginning and ending class ______
18. Keeps class under control (doesn't let a few individuals dominate discussions, etc.) ______
19. Is concerned that his students grasp the material presented ______
20. Properly assesses the amount of outside work (homework) appropriate to the course ______
21. Makes homework a useful experience ______
22. *Willingness* to consider questions from students ______
23. Encourages class participation through the maintenance of a suitable informal atmosphere ______
24. Willing to listen to divergent or opposing contradictory ideas or viewpoints (is open-minded) ______
25. Accepts criticism or suggestions from the students ______
26. Willing to admit mistakes or lack of knowledge ______
27. Willing to help individual students outside of class ______
28. Shows interest in students as people (knows names, etc.) ______
29. Respects students knowledge and opinions ______
30. Treats all students fairly and equitably ______
31. Sense of humor ______
32. Self-confidence ______
33. Taking everything into account, I consider this instructor ______
34. Taking everything into account, I consider this course ______

Discussion: A Basic Framework for Policy Education

WALLACE BARR

In his humorous, illustrative, and unique manner, Kohlmeyer has given us some of the generally accepted practices and some techniques used in most successful extension policy education programs. His suggestions: (1) specialize, (2) develop a high degree of competence, (3) provide a decision-making framework, (4) pre-plan with local and area personnel, and (5) provide technical assistance as needed. The best evaluation in extension that I know is, "Do you get the second and third invitation?"

His expertise is greatly enhanced by his ability to communicate with people. His "homespun philosophy," vast experience, and well selected illustrations provide him an almost instant audience rapport. Most of us do not have this ability. Each of us needs to develop his own personal techniques to gain audience confidence.

My own conception of the basic framework for policy education was merely alluded to in the presentation. As I view the policy framework, it involves taking people through the process of (1) developing a common understanding of the situation, (2) defining the issues, (3) identifying the alternatives, and (4) determining some of the consequences of various solutions. Each person then determines for himself, within his value system, his choice of alternatives. The principles and techniques of operation developed are used in planning, implementing, conducting, and evaluating the program.

A Policy Program

A fundamental objective of policy education is to provide the basis for people to take more intelligent action through proper channels—whether in the ballot box, through organizations, or with legislators. This implies a policy education program on a major problem area. A policy education program needs to reach (1) the masses, (2) local community leaders, and (3) leaders of special interest groups. A balanced effort directed toward these audiences, conducted by competent staff utilizing the policy framework and properly implemented, should result in an effective policy education program.

Mass media efforts are important to create awareness and are an important part of a total educational program in policy, but alone are insufficient. Working with the leadership of special interest groups at the area, regional, or state level is an integral part of an educational program in

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policy. These are the key people who "get things done" within the political power structure. Influential leaders at the local and area level are very important in the group decision-making process who I fear are too often overlooked in extension policy education programs.

We in Ohio have moved in the direction of intensive and in-depth training for selected local leaders in two major policy problem areas. Our successful community development program involves about 12 hours of intensive study of local community problems as identified by a local planning committee. The enrollment consists of selected people who can influence future community decisions and help determine future directions.

Food and Fiber Marketing Policy Seminar

To provide a setting and climate for discussion of some of the economic, political, and social factors involved in our marketing system, we are conducting food and fiber marketing policy seminars. Broad objective of the seminar is to develop in individuals the understandings needed to make decisions concerning the market system and institutions. The seminar consists of "core" and "optional" subject matter; its program is highly flexible, open ended, and requires intensive local planning by a selected group of six to twelve leaders representing the farming and agribusiness interests of a two- or three-county area.

The general format calls for three all-day sessions, usually a week apart, providing 15 hours of instructional and discussion time. The seminar audience is limited to 40 to 60 people who are carefully selected as representative local leaders. Each pays a fee of $10 to $15 to cover the cost of materials, room rent, fees of selected speaker, and luncheons.

The core subject matter deals with the structure of farming and the marketing system, price determination, and social and economic values. Five hours of instructional and discussion time are allocated to these areas.

The optional topic areas chosen by the local committee may include bargaining, foreign trade, land retirement, market orders, promotion and advertising, low income farm policies, reducing price risks, inflation, politics of agriculture, or any other subject matter felt to be appropriate by the local planning committee. The broad subject matter areas are subdivided into manageable units and given popular titles.

A typical food and fiber marketing policy seminar contains three or four of the optional subject matter topics. Usually four to six different departmental staff members are on each seminar program, although some seminars require "outside" personnel.

This approach provides a sound educational environment in which people can explore in some depth and within an analytical framework. The various alternatives are evaluated, considering peoples' values and in view of the expected economic, social, and political consequences.

The process, though slow and unsensational, is nevertheless effective if extension agent, participant, and administrative opinion are valid criteria. This approach has paid large dividends in public understanding of numerous marketing policy issues. The in-depth policy programs (community development and marketing policy) have enhanced the image of the cooperative extension service and the university with traditional audiences. They have attracted many new supporters.

Discussion: A Basic Framework for Policy Education

W. FRED WOODS

Whether or not the true goal of agricultural economics is to be a handmaiden of policy [3], the extension policy specialist is more or less intimately involved in the area. The explosion of change—technological, social, institutional—has expanded the need for policy education.

In our society the collective citizenry presumably make the important decisions. They vote their convictions, elect candidates who express certain views, and exercise collective and individual voice through various pressure forms. The continued success of our, or any, free economic and political system depends upon informed citizens who exercise their right (perhaps we should say, their responsibility). These statements have always been true, may even sound trite, but they take on a more important meaning today.

Extension has had public policy, or public affairs education programs, at least on paper, for many years. But there has been considerable more talk than action in this area. Ratchford, in 1963, observed, "There are very few examples of truly outstanding public affairs programs of sufficient depth and scope that decisions on public issues have actually been influenced" [4]. In 1969, with the exception of a few states, I see the situation largely unchanged.

Professor Kohlmeyer and his state are among the notable exceptions. Writing as he does from an established base of operation, his words are given added authority. The foregoing notwithstanding, there is little room for disagreement with Kohlmeyer's paper. The only possible reservation I have is this one: J. B. Kohlmeyer can operate in this manner. Could I?

A successful policy educational program involves, first of all, an important administrative decision. Meaningful educational programs in this area cannot be conducted without encountering controversy. The very essence of public policy problems suggests conflict, compromise, and consent [1].

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Public policy issues are often characterized by strong vested interests. These interests want either one of two actions from the Extension Service: (1) they want Extension to advocate particular policy positions, or (2) they want to prohibit Extension from operating at all in the area of public policy.

There is a wealth of material available on most public issues but much or most of it is necessarily biased to reflect the views of the organization, private or public, that puts it out. There is a great need for some organization to do a thorough and unbiased educational job on public issues. Who is at least theoretically better equipped to do this job than the Cooperative Extension Service? Therein lies the administrative decision. To meet an obligation or to ignore it—that is the question.

Once the decision has been made to conduct an educational program in the policy area, we are ready for Mr. Kohlmeyer. Policy education is truly different from other extension educational efforts. Where most extension specialists give specific recommendations, the policy specialist must deal with a range of alternatives and their consequences. To me an analagous situation would compare the mechanic who works on the car with the engineer who designed it.

Whether the policy specialist deals with already known alternatives or does the inventing to afford new choices that Kohlmeyer calls for, the potential rewards are great—an enlightened population and a stronger nation.

The future of Extension may well be in this area. In a satirical approach, Professor Cyril O. Houle of the University of Chicago related the story of how the Extension arm of a mythical land-grant university finally broke with tradition and entered into a program of public affairs education [2]. As Houle relates, "A surprising thing happened to the Cooperative Extension Service. As soon as it stopped thinking about its glorious past, it turned out to have a glorious future."

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AGRICULTURE AND THE LAW

CHAIRMAN: W. B. SUNDQUIST, ECONOMIC RESEARCH SERVICE, USDA

Institutions and Instruments—Management Alternatives

N. G. P. KRAUSZ AND F. J. REISS

INSTITUTIONS, and their accouterments of laws and legal instruments, develop from man's responses to his needs in relation to other men. However, once established through usage and general acceptance, institutions tend to govern and determine behavior rather than be a product thereof. Laws, conventions, institutions, legal instruments—all tend to effect a conformity in the individual's behavior and response to social and economic situations. In a stable society, such conformity in behavior may contribute much toward a smoothly functioning and peaceful existence. It does not, however, result in progress, unless progress is defined as extending the status quo.

From simple curiosity and observation to highly organized research, and from direct conversation to sophisticated satellite communication and formalized instruction, man's knowledge horizons are rapidly expanding and intruding upon the status quo. Inevitably, institutions, laws, and their accompaniments are confronted with a changing environment. Agriculture has not been untouched by problems of change.

It is not our purpose to elaborate and document the changes that have brought us to our point of concern, but it will be useful to recognize some of the dynamic aspects of the agricultural economy as a background for our discussion. Among these are the following:

(1) Farms are growing larger, more highly mechanized, and more specialized in their production.
(2) Substitution of capital for labor, largely a matter of mechanization and automation, greatly increases the amount of capital associated with one man's labor.
(3) Farm production is highly market oriented, which makes farmers sensitive to price changes and creates a demand for greater producer control over marketing and price-determining processes.
(4) Inputs generated within the farm firm have almost disappeared.
(5) Management in the organization and operation of farm firms is more critical to success and survival than ever before.

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All of these developments create and present problems legal and institutional in nature. Traditional and established practices and procedures may now be impediments. Instead of playing a facilitating role, institutions and customs may inhibit desired changes in the following ways:

(1) They affect and limit the allocation of resources, among uses and users.
(2) They may restrict use of resources to less than optimum amounts because of uncertainties in the rights of possession and use.
(3) They may create or contribute to dissociations between ownership of inputs and claims upon returns.
(4) They may contribute to inefficient use of resources.

In these and other ways, established and institutionalized arrangements may actually impede economic progress. There is another side to the coin, however. The borrower needs someone who would be a lender. The tenant needs a landlord. And the specialized manager of a farm business must find an employer, a man (or men) with land and capital resources. Their needs, too, must be considered.

A key concept in considering legal instruments and institutions is the individual as a responsible agent, responsible for the management and use of resources, accountable for infringement upon the rights of others, obligated to perform as required under contracts, expected to make payments for goods and services received, obliged to repay borrowed capital, and liable for the consequences of forces set in motion and actions initiated by him. This person economists have identified as the entrepreneur and have recognized his contributions, through his decision making and accountability, to the productive process.

The instruments and institutions that spell out and document the entrepreneur's rights and responsibilities are a product of the prevailing technology as well as of the structure of society. Thus, a high degree of personal responsibility was appropriate to small family-operated farms organized as single proprietorships—but is such responsibility equally appropriate to productive organizations whose assets may greatly exceed the net worth and financial accountability of the individual entrepreneur?

Our answer, of course, is negative. Society has long used legal and institutional devices to relieve the farm operator of a large share of such burdens. Farmers rent land and borrow money. They contract for supplies and for the delivery of products. They hire labor and services. But the growing dimensions of the typical farm firm, the increased functional specialization, and other consequences of technological changes leave at least some of these arrangements quite inadequate and/or inappropriate.

This is the context in which we shall look at our current inventory of devices employed in the past and some emerging in the future.

Economic—Legal Issues

In studying relationships between economics and law, it is useful to examine some conceptual differences between the two fields. Economics is the discovery of rules and principles and their application to a working situation. Law is the attempt to create rules for an orderly society. For example, economists consider land as a natural resource and buildings as capital; therefore, as separate components. Lawyers consider land and buildings together as "real estate." As real estate, it makes the establishment and recording of ownership easier, simplifies the distinction from personal property, and facilitates the transfer of title from one owner to another.

Some legal rules are more flexible than others. Contract theory has allowed wide innovation in the structuring of economic component relationships. However, agricultural institutions and customs, such as the share lease and the family farm, have limited the opportunity for new organizational forms and specialized relationships to develop in agriculture. Relationships by "custom" do not always act fairly in allocating control, risk, and return to the participants.

In contract problems the parties themselves and the courts can overcome inequities; but in the case of established institutions, questions of policy are raised and thus state and federal executive and legislative bodies may be involved. Law and legal institutions being of political origin, the question of changing established arrangements is in fact a political one. Because great numbers of various types of people are involved, it is also a social problem. Legal institutions and their consequences are the result of political attempts to solve economic and social problems. In analyzing the agricultural legal structure, consideration must be given to social and economic reasons for the particular way in which it has developed and the impact of changes upon society.

The basis of current U. S. agricultural structure is the small owner-operator theory of early land distribution laws. Agencies such as the Extension Service have perpetuated the family farm type operation by providing information, research, and other services which individual operators of this size could not alone afford. Government farm programs also have encouraged the continuance of this type of operation by assisting farmers financially so they can remain in farming.

Laws have influenced agricultural structuring through their effect on the land-people relationship. In the past, the ownership of land was the key. But rights in land, though often more formal, are actually less absolute than rights in personal property; that is, they are more subject to split ownership or to restriction on their use. For example: (1) Leases represent a temporal interest in land, a means of allocating the income from land, and a means of controlling land use via covenants and other provisions; (2) Tenancy in common permits undivided co-ownerships in land; (3) Joint tenancy limits transfer alternatives through its right of survivorship provision; (4) Life estates are only a beneficial interest in land, but with elements of trusteeship; (5) Easements constitute a restriction on a servient tenement and an asset to a dominant tenement; (6) Police power through zoning regulations can restrict freedom of use; (7) Nuisance laws impose similar restraints on freedom of use; (8) Eminent domain affirms the superior right of society to the use of privately held land; (9) Adverse use is a socially derived principle against perpetual neglect or non-use of privately owned land; (10) Statutes of limitations cut off title interests when abandoned or carelessly guarded; (11) Land registration is an ownership defense not required of personal property.

In the area of contract law, most restraints are non-legal except as the relationship intended establishes one of the durable institutions. Probably the most severe restraint is the impact of taxes. Otherwise, the contract is a malleable instrument receptive of the wildest dreams or the indurate agreement of callous businessmen.

Statutory and case law provide stability, and this must be so for faith in future application. Legal precedent is the bulwark for contract, investment, and ownership. However, this also explains the tardiness of law. Law follows economic and social needs and pressures—it rarely leads. A most pressing case must be made for any change in legal institutions.

Fee Simple Concept

The historical base for land law is the fee simple concept—in theory allowing maximum utility and minimum interference. Also, the ultimate in privilege—to be allowed to transfer all title rights to beloved or friend at death or inter vivos [1].

The liabilities of fee ownership have grown immensely—liablity for tort, for nuisance, for taxes, for maintenance. Restrictions have multiplied—zoning controls, land use plans, special districts forcing in the minority, elimination of access, public easements, cropping limitations, statutes of limitations, pollution controls, labor rights, and so on. The quantum of the fee simple concept has indeed been eroded.

Fee simple ownership has become less important concomitantly with a decreasing voice in the use of land. As land prices increase and returns on investment decrease, operations with owner-operator-control splits will increase. As vertical integration shifts more and more functions off the farm, it becomes less vital that the operator own the land and other assets he operates. Land pool companies and futuristic securities market in land further widen the fee simple owner-control split.

The right to divide the fee into parts, equal and unequal, also is of ancient derivation. It is miraculous that our laws of descent have not caused the same disastrous physical splintering as in Europe. Joint and fractionated ownership have caused management problems in the United States but have not prevented the enlargement of farm units. Shared ownership may now be considered an economic blessing because of high capital inputs.

Possession Separated

Tenancy is one of the oldest institutions for separating the function of ownership from those of possession and use. In spite of its age, farm tenency is an extremely important tenure institution today. This is especially true where land values are high and among young farm operators. The dissociation of title and possession obviously must be allowed by law. Tenancy has lost its stigma, allows younger people to farm, particularly the higher priced lands, and also permits expansion by owners of undersized units. Without a strong tenancy system, the old and the misfit might be sowing our seeds.

Most of the recent growth in size of farm has occurred through renting of additional land. As a result, the typical operating unit [8], at least in the midwest, greatly exceeds the size of the average ownership unit. Many part-owners, as well as full tenants, are renting land from more than one owner. Some landlords have turned to "custom farming" arrangements in place of share-renting, while others are trying cash leases to increase their net return. Some tenants view cash leases as a means of competing more vigorously for land to enlarge their farms. Others see cash leases as a means of gaining greater managerial freedom and flexibility when renting a large acreage from a number of independent owners.

The institutional arrangements and the customs associated with share-renting are being challenged, and one can ask why. Why abandon the comfortable stability of the 50–50 crop-share lease that permitted, if not actually encouraged, much of the technological progress in raising American farm productivity to unequalled levels? Landlords have answered that they need more rent or that they want to be relieved of the burdens of management incumbent upon a share-rent owner. Tenants have admitted to competitive bidding for land and to a desire for greater managerial freedom.

Fundamentally, these and many other responses, are an expression of three major problems in determining the structure of farm firms: (1) How can an adequate quantity of resources be obtained by a prospective farm operator to create a firm that can operate efficiently? (2) How much are individual factors of production worth? (3) What arrangements can provide the desired assurances of possession, tenure, and managerial control?

The first problem area is part of the overall question of allocating scarce means of production among alternative uses. Specifically, the creation of a farm business assumes the presence of a responsible personal entity, typically an individual entrepreneur, who will make commitments to pay for the use of resources owned by others and/or accumulated through personal saving. These commitments are evidenced by such documents as leases, mortgages, deeds, and contracts. It is here that convention and custom exert their influence in hindering or facilitating the creation of adequate farm firms.

The second problem area, that of valuing individual inputs or factors of production is, in theory, a problem of determining or approximating marginal value products. Just how much is land worth? How much annual net rent can a farm operator afford to pay for an acre of land? How much net income will be generated by adding a second or third tractor, or a hired man, or an employee who assumes managerial responsibilities? Few farm operators have good answers to these questions. They accept market prices as uncontrollable variables, and decisions to buy or invest are not infrequently made on the basis of ability to pay rather than on an expected return ratio.

Economists have attempted to answer such questions academically with the aid of costly statistics and costlier equipment [11]; but farm operators, less well fortified, must answer such questions in terms of personal commitments. It is small wonder that they hesitate to deviate from customary arrangements, because these arrangements may constitute the only expression of a market price for the services of such unpaid inputs as land and entrepreneurial labor.

Share leases tend to avoid the problem by becoming quasi-partnerships with the landowner sharing in production and price risks and in a variety of costs [9]. The economic rent for land is disguised behind a number of associated non-land inputs. As a result, there is a reluctance to deviate from established practice; and questions of adopting new inputs such as new methods of crop harvesting, conditioning and storage, or herbicides as partial substitutes for mechanical weed control, become involved in the land rental problem.

In theory, cash leases should solve these cost-sharing problems, and indeed they do, but then the problem of approximating the annual worth of land stands in bold relief. When problems of risk and greater capital requirements for the operator are considered, the net gain may be questionable. In a dynamic and variable economic environment cash leases have problems of their own. For example, assume that one starts with a fair and equitable gross cash rental; will this rental be fair and equitable for the next year, or the one after that [7]? Are we not putting rent determination on bargaining strength rather than a land productivity basis? Or, given a highly competitive rental market, do we not increase tenure uncertainty if land control shifts capriciously to the highest bidder?

This brings us to the third problem area—what can be done? Much good work has already been accomplished in developing farm lease forms that remind their users to arrive at mutually satisfactory agreements on a number of potentially troublesome questions. Basic principles, such as sharing variable costs in the same proportion as returns, are well established but need to be taught to tenants and landlords [10]. But it is equally important to teach appropriate accounting and budgeting procedures, whereby farmers and landowners can do a better job of estimating changes in costs and returns from new practices, and how to use such information to make enlightened changes in farm leases or operating contracts [10]. Dependence on or retention of traditional institutional arrangements may render a questionable service to agriculture unless the capacity of entrepreneurship can be raised to modify such arrangements to accommmodate a changing technology.

The life estate institution, another separation of possession from title, has rigidities that seriously weaken its use if the public interest is considered. Remaindermen, even if mature and capable, are legally devoid of management, and have only the vague and disarming right to prevent waste. The life tenant is limited to land surface use, with no right of alienation and virtually no security for borrowing. Legal instruments can be used to vary this inflexible institution and the problem should be examined for greater elasticity. It is a gritty issue however, because of many vain males and a strong desire to protect children [5].

Title Divested

An area of intense legal study is the divestiture of title in exchange for intangible interests. The conversion is from real to personal property, which substantially affects the prestige of the security. Credit sources often require corporate owners to surety the very institution they created and which holds the title. This enigma could be eliminated by changing our security laws but it would be an admission that the conversion to intangibles was incomplete. If there is any fault, it probably lies in the weakness of an institution not so readily adaptable to the small firm. A mini-market for corporate shares also causes other problems such as locked-in shareholders and the use of book values for buy-outs [2].

However, the corporate institution is sufficiently viable and the supporting instruments amply flexible to allow a liberal supply of corporate advantages for the small firm. The fringe benefit package does not bristle with an opulent flow of gifts but many of the restraints on insurance, pensions, and stock transfers can be overcome by judicious drafting.

The management advantages are several if capital resources are adequate: (1) a complete separation of labor, management, and ownership is permitted; (2) the management contribution can be more readily ascertained and appropriately compensated; (3) management can be centralized, but additional voices can be allowed in policy making, (4) substantial ownership can be transferred without loss of control; and (5) top management is more apt to be retained as ownership changes.

Twenty Illinois farmers who recently incorporated on a family basis replied [6] that they had four primary objectives: (1) to maintain an adequate sized farming unit for the children; (2) to lower inheritance taxes and transfer costs; (3) to gradually shift ownership without losing control; and (4) to inspire interest and management participation by the children.

Other reasons given included: (1) to reduce the total income tax by adding another taxpayer (the corporation) and by creating additional deductions (e.g., depreciation of residences and medical and group life insurance); (2) to obtain fringe benefit advantages for the owners; (3) to limit liability; (4) to obtain purchasing discounts; and (5) to facilitate expansion of the business.

It is noteworthy that operational economic considerations are secondary and that the dominant motives related to intrageneration transfer, with a deep feeling of protection for the family. The corporation structure appeared to them to best meet their needs without immediately sacrificing serious loss of control and the security of an ownership interest in land.

It also is remarkable that 80 percent of these farmers, with assets averaging $400,000, incorporated only in the past six years. They have suffered from lack of knowledge about more sophisticated organizational methods plus the fact that existing legal institutions have fulfilled only a part of the needs of closely held businesses.

In states where permitted, the land trust is an excellent substitute for the corporation if estate planning is the dominant motive. However, in some cases it may afford another choice to horizontally integrate similar production units as a bargaining tool of small landholders against large operating corporations.

A few states have refused to label these trusts as "dry" and only a title holding function is allowed for the trustee. Management is retained by the beneficiaries who often designate one of their own as manager. Beneficiaries own personal property interests that are transferred much like a corporate share of stock. The instrument involved is an unrecorded agreement between grantor and trustee (sometimes the same person). This device allows low cost planning and distributions without partitioning the land and merits the attention of more states and more farm owners.

Title also may be held by a partnership and, with well drafted agreements and buy-outs, can simulate the corporation in many legal ways. The most severe legal blocks are unlimited liability and judicial dogma that a partner can only be an employer. The liability rule has little practical significance in the tort area of law, but it is relevant when fraud and unauthorized contracts are used [3].

The partner-employer rule disallows business deductions for fringe benefits they receive from the partnership. If partners could be employees as well as owners, a concept enjoyed by shareholders employed by their own corporation, the attractiveness of the partnership would be substantially enhanced. This possibility does exist for a limited partner, but it would be impractical to have limited partners in many situations.

In spite of some trepidation, farm corporations and partnerships are replacing a number of single proprietorships. They appear to have solved or avoided the three problem areas of acquisition, valuation, and control of resources; but this may be an illusion. Shares in the family farm may be locked-in, thus avoiding or minimizing acquisition costs for sizable land and capital inputs under a family corporation. However, they may also represent an alien, unfriendly, or uncooperative ownership interest. Furthermore, a fair and equitable distribution of earnings requires a working knowledge of marginal value products coinciding with the differentiated ownership or contribution of factors.

The corporation appears to be an ideal way (1) to relieve the manager-entrepreneur of the burden of furnishing or being responsible for all capital inputs and (2) to pool the equity resources of a number of people in achieving a desired scale of operation. The corporation, as a legal-personal entity, is capable of accommodating virtually all sizes of enterprises above certain minimums. It may be precisely this capacity for bigness that has brought the corporation in agriculture under criticism.

The family farm business is, by definition and otherwise, subject to effective restraints on its size. It has a characteristic of direct personal association between the owner-operator (and his family) and all or most aspects of the business. The corporation, on the other hand, may be impersonal in its human relationships through the specialized roles of its directors and employees. Inherent in these differences are the bases for value judgments concerning corporations in agriculture. The economist insists on a neutral position with respect to personal or social value judgments. They may be introduced into his analyses as parameters or as variables if they can be quantified, but the economist qua economist does not make value judgments. The corporation, on the other hand, is totally indifferent to value judgments. Hence, we have the question, as individuals, and as members of society, as to what, if any, restraints on size and growth, on scope and activities, and so on, we wish to place upon the legal-institutional arrangement known as a corporation.

Title Holding and Transfer Problems

A benevolent system of government allows private ownership of the surface and the subsurface, and the transfer of either or both during life or at death, in a variety of ways. At least 20 different estates and interests have been carved out of fee simple. We have so many interests, there is difficulty in keeping accurate public records because of marriages, death, divorces, descent laws, adverse possession, joint tenancy, wills, dower interest, insanity judgments, statute of limitations, contracts of sale, prescriptions, assessments, tax claims, mortgages, attachments, easements, leases, conditions, life estates, contingent interests, etc. One could in innocence ask what new is needed—what does the market require now? Has the law not already over-responded to economic and societal needs for different interests in real estate and for different kinds of institutional arrangements?

The answer, of course, is that title to any property is not held in isolation and must accommodate itself to new impingements of a society and government in flux. The impact of income and death taxes alone demand innovations for avoidance. The lack of farm estate management can strap succeeding generations with a debt structure that forces sales and strains credit sources for operating capital. The use of substantial gifts and life interests, often via the trust route, have captured the imagination of owners and attorneys in the past two decades.

A title transferring arrangement of increasing popularity is the installment land contract [4]. With low equity, it is a financially painful way to climb the agricultural ladder, but it does put land resources at the disposal of an operator not endowed with generous amounts of equity capital. Within families such sales are most appropriate for the buyer if combined with other land transfers on a gift basis or the periodic cancellation of a portion of the installment payments [4].

For the seller, installment contracts have more to offer. The income tax generally is less; steady annual payments can be relied on for retirement purposes; the income is not subject to social security tax, nor does it reduce benefit payments; the security still is the land; the price is pegged for death taxes; and management responsibility is transferred to the buyer. In addition, an estate can be gradually reduced by consuming or making gifts of the installment payments. Where such reduction is not desired, the seller faces an aggravated reinvestment problem.

Transfers at death are least painful to the deceased. Our secret "willing" process is reasonable, but some desire exists for a public disclosure that would be binding on all parties even before the owner's death. There certainly would be management implications if it were known in advance who is to receive the property.

The absurd parts of contemporary wills relate to taxes. A one-or two-page will often is expanded to ten pages to include stereotyped marital and non-marital trusts. What could be a $25 will becomes a $150 will. This seems ludicrous to many persons and rightly so. At least 90 percent of this common language could be placed in the law and incorporated by reference in a will. With simpler wills, more would be used, which again has strong implications for management policy and choices.

The pressure of taxes sways most business decisions, and indeed the form of organization, toward vantage grounds of least impact. The slow gaited may be struck with a tax load many times that of the perceptive businessman.

Planned reductions of death taxes for an average farm estate often are equal to several hundred thousand dollars of gross income. The penalty for inaction may be an extra eight years of hard labor for someone in the family; or, conversely, it may allow retirement eight years earlier.

It is ironic that most property values have multiplied four to eight times in the past 20 years but death tax exemptions have remained static. At a time when farm firm assets are substantially increasing, the size of individual holdings is severely restricted by the impact of death taxes, and gift taxes partially absorb inter vivos transfers. It is a period in our economy when non-ownership of realty and operating assets is becoming much more attractive.

Final Comment

It may well be that a societal value judgment favoring small holdings and widespread diffusion of land ownership is superior to any possible gains in efficiency of resource use. Even after allowing for maldistribution of food resources, our nation is not suffering from an inability to feed itself. The marginal value of social gains inherent in institutional by-products may well exceed that of possible increments of food and fiber production. Our examination of instruments and institutional arrangements suggests no serious lack of means to get what we want, but rather a gross inability to agree on what is wanted, or indeed, needed.

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Do Legal and Tax Rules Favor Large-Scale Agricultural Firms?*

NEIL E. HARL

THE assigned title of this paper necessarily implies an examination of the extant income tax and legal structure rather than a normative view. Accordingly, those facets of the legal and tax structure impinging upon large-scale agricultural firms uniquely and peculiarly vis-a-vis small-scale farm firms are examined herein.[1] While occasional reference is made to the legal and tax structure of the large-scale farm firm vis-a-vis comparably sized non-farm firms, that issue is not considered to be within the purview of this paper.[2]

General

Although the term "scale" has acquired general significance in economics, legal patois has never accorded the same degree of significance to scale or size per se. The relativity, dynamic character, and absence of a single descriptive dimension of size and scale have discouraged use of the terms as touchstones for legal restraints and tax policy.

Perhaps in part as proxies for size and scale, legal and tax rules have been based upon such features as form of organization, type of firm, and occupation of individuals involved. Form of organization is perhaps the most important variable in explaining differential treatment of firms legally and from an income tax standpoint. Even in instances where size or scale has been the apparent target, legislation has tended to focus on forms of organization such as the corporation. This has created anomalies in numerous instances, inasmuch as the traditional forms of organization —sole proprietorship, general and limited partnership, trust, and corporation—may be and are being used by firms throughout the size or scale range.

The title to this paper suggests, by implication, a benchmark legal and tax system against which large-scale firms should be tested in determining whether they are favored by extant legal and tax structures. Inasmuch as

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[1] The differential effects, by size of firm, of federal price support and income maintenance programs are considered beyond the scope of this paper.

[2] Entry of non-farm firms into agriculture may be encouraged by favorable investment opportunities not fully available elsewhere. A combination of cash basis accounting, deductibility of farm depreciation and expenses against non-farm income and sale of property held for use in the business at capital gains rates provides attractive investment possibilities. See [3].

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the predominant organizational structure for the farm firm continues to be the sole proprietorship, the legal and tax rules relevant to "large scale agricultural firms" are tested against that standard.

Legal (non-tax) Rules Peculiarly Affecting Large Scale Agricultural Firms

State limitations

With large-scale farm firms tending toward use of the corporate form of organization,[3] interest in limiting size or scale of farm firms has occasionally been translated into restrictions limiting or denying the right of corporations to hold land or operate farm businesses [9]. Such legislation may reasonably be interpreted, at a minimum, either as not favoring large-scale agricultural firms or not favoring the corporate form of organization per se.

North Dakota law, while permitting the formation of farming cooperatives by five or more adults if 75 percent or more of the members are actual farmers residing on farms or depending principally on farming for their livelihood, has prohibited all types of farm corporations since 1932. A referendum vote in 1968 defeated an attempt to legalize closely held farm corporations.

From 1931 to 1965, corporations in Kansas could not engage in the business of "producing, planting, raising, harvesting or gathering wheat, corn, barley, oats, rye or potatoes, or the milking of cows for dairy purposes." In 1965, the Kansas law was amended to permit closely held corporations not exceeding 5,000 acres to engage in the prohibited purposes.

In Minnesota, corporations organized for and engaged in farming operations may not acquire more than 5,000 acres of land. Texas law does not permit corporations to engage in the business of raising cattle and owning land for that purpose nor the business of operating stockyards and of slaughtering, canning, curing or packing meat. West Virginia imposes a one-time special tax of 5 cents per acre on corporate land holdings over 10,000 acres. An Oklahoma constitutional provision specifying that a corporation could not "buy, acquire, trade or deal in real estate for any purposes except such as may be located in . . . cities and towns . . . and further except such as shall be necessary and proper for carrying on the business for which it was chartered or licensed," has been held not to prohibit land ownership by farm and ranch corporations. A few other states place similar broad, general limitations on corporate ownership of real estate.

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[3] The exact number of farms operated by corporations, partnerships or trusts by size classification is not known since the Census of Agriculture has not, in the past enumerated farms by method of organization. Available data suggest that the average size of farm corporations exceeds by several times the average size of farm [12, p. 13; see also 4, 14]

Most states provide that certain property of an individual debtor is exempt from execution by creditors.[4] The exemptions are most generous in heavily agricultural states and to farmers as debtors. Property owned by a corporation is generally not similarly exempt inasmuch as exemption provisions typically apply only to "heads of families" or "married individuals."

Federal restrictions

Federal limitations applicable to large-scale agricultural firms pertain principally to eligibility for loans by federal lending agencies and rules for participation in reclamation projects. Limitations on maximum payments that may be received under price stabilization programs have been considered by the Congress from time to time but have not been enacted into law to date.

Federal lending policies.—Various types of loans from federally sponsored credit agencies are either unavailable to farm corporations or significant limitations are imposed on loans to farm corporations. Neither Farmers Home Administration real estate loans nor FHA operating loans may be made to farm corporations. Corporations engaged primarily in farming, however, are eligible for emergency loans and may participate in the emergency feed program. FHA soil and water loans may be made to corporate grazing associations.

Federal Land Bank and Production Credit Association loans may be made to a farm corporation if limitations are observed with respect to source of income, occupation of shareholders, and shareholder limited liability.

Bankruptcy and exemptions from execution.—Since the early days of federal bankruptcy law, individual farmers and partners in farm partnerships have been permitted to file a petition as voluntary bankrupts, but could not be declared a bankrupt involuntarily. A corporation engaged in farming is afforded the right to be a voluntary bankrupt but is also subject to involuntary bankruptcy if it owes at least $1,000 of debts and commits one or more of the six "acts of bankruptcy" within four months of the time the petition was filed.

Reclamation project rules.—Early federal land policies, directed toward encouragement of settlement of the west, contained acreage limitations which have been continued down to the present in various forms.

The Reclamation Act of 1902[5] limited the area for which the use of water could be sold to 160 acres. At present, water right certificates for reclamation water use on lands in private ownership are limited to 160 acres per owner unless construction charges have been paid. The sale of excess lands acquired in connection with federal irrigation projects may not exceed 160 acres per person. Under a 1953 act authorizing the exchange of tracts or additions to tracts in federal irrigation projects to create farms "sufficient in size to support a family," the maximum size of any resulting unit is 320 acres of which not more than 160 acres may be irrigable. And applicants for entry on Federal reclamation lands presently must not own more than 160 acres of land in the United States.

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[4] E.g., Iowa Code §§ 627.6, 561.21 (1966) (farmer may hold exempt, inter alia, five hogs and all pigs under 6 months and a 40-acre homestead of unlimited value).

[5] 32 Stat. 388, 389, 43 U.S.C. §§ 381, 392, 431, 439 (1964).

Differential Tax Rules for "Large-Scale Agricultural Firms"

Federal and state income tax rules have generally been developed and applied on the basis of the legal nature of the taxpayer; size or scale of the taxpayer have only rarely been deemed relevant variables in income tax imposition.

Tax rules explicitly recognizing size of firm

Expenses incurred for clearing land to make it suitable for use in farming may be deducted currently, if the taxpayer elects, rather than being added to the basis of the land. However, current deductions are limited to the lesser of $5,000 or 25 percent of taxable income from farming. This provision tends to favor land clearing by farmers with taxable incomes of $20,000 or less per year.

Other rules peculiar to farmers, including deducting expenditures for fertilizer and lime, reporting commodity credit loans, claiming deductions for soil and water conservation expenditures, and filing estimated tax returns make no distinction as to size or scale of farmer.

Depreciation and investment credit rules, except for extra first year 20 percent depreciation, contain few size or scale limits explicitly. Investment credit has been limited to the amount of tax or $25,000 plus 50 percent of the tax over $25,000. Used property eligible for the credit has been limited to $50,000 per year. During the 1966–67 suspension, the investment credit was limited to $20,000 in purchases, and a ceiling of $50,000 was placed on certain kinds of depreciable real property eligible for fast methods of depreciation. Extra first year 20 percent depreciation is limited to a maximum of $2,000 per taxpayer (including a corporate taxpayer) or $4,000 for a husband and wife filing jointly. In this instance, a farmer filing jointly with a spouse thus has an advantage over large-scale farms operated as corporations.

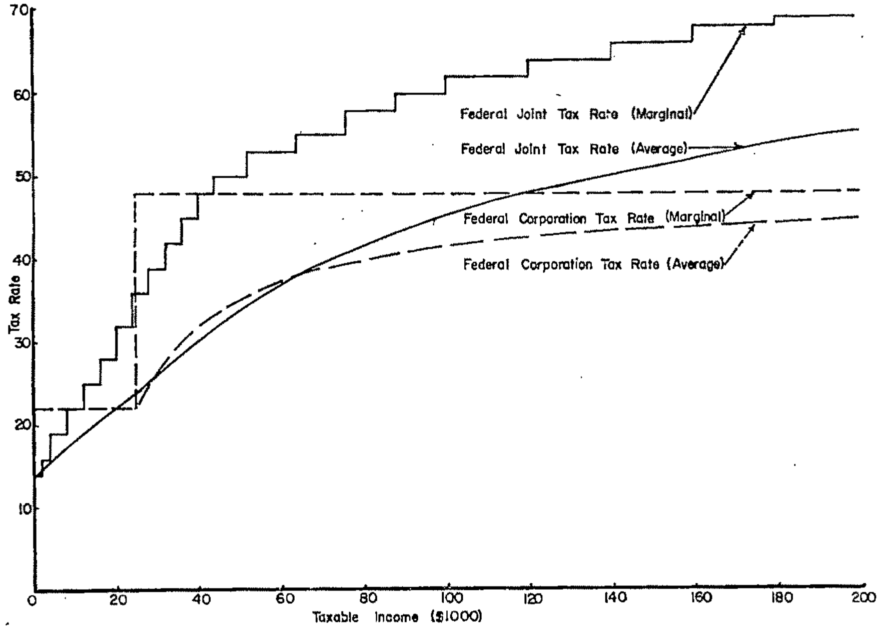

Figure 1. Individual and corporate Federal income tax rates

Differential tax rules by form of organization

Income tax differences are accorded firms operated as sole proprietorships, partnerships, trusts, and regularly-taxed or Subchapter S[6] corporations. Since sole proprietorships have traditionally not been taxed as separate entities but with the income taxed to the individual taxpayer, and since partnerships and Subchapter S corporations in effect pass income and losses to partners and shareholders, respectively, to be reported as individual taxpayers, the essential comparison is between the income tax treatment of a corporate firm and a firm operated as a non-corporate taxpayer.[7]

Comparisons between individual and corporate tax treatment are complicated by the conceptual differences between the two classes of taxpayers. Regularly taxed corporations are taxed as separate entities. Since corporations do not have ability to pay in the same sense as individuals, the corporate income tax rates do not parallel individual graduated rates [15] Currently, corporations pay tax on corporate taxable income at a rate of 22 percent on the first $25,000 and 48 percent on all taxable income over $25,000. These marginal rates compare with individual rates of 14 percent on the first $1,000 of individual taxable income up to 70 percent on taxable incomes above $200,000 for married taxpayers filing jointly. Marginal and average rates of individuals and corporations are compared in Figure 1. These rates are exclusive of the 10 percent surtax applicable for 1968–69.

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[6] Subchapter S corporations are taxed similarly, though not identically, with partnerships. To elect Subchapter S status, a corporation may have not more than 10 shareholders who must be either individuals or estates, all shareholders must consent to the election, and not more than 20 percent of corporate gross receipts may come from rents, royalties, dividends, interest, or gains from sale of stock or other securities. In a Subchapter S corporation, ordinary income, capital gains, and operating losses are reported by the individual shareholders for income tax purposes.

[7] The tax-free exchange rules used by so-called conglomerate firms to accumulate capital through acquisitions are peculiar to the corporate form. Inasmuch as restrictive legislation is indeed likely in this area, discussion of the opportunities under current law is not included herein.

Figure 2 depicts the total income tax burden for a hypothetical firm and the individuals involved, for net incomes ranging from $10,000 to $200,000 annually, under assumptions of 50 percent (curve I (A)) and 70 percent (curve I (B)) of firm income paid out as salaries with the re-

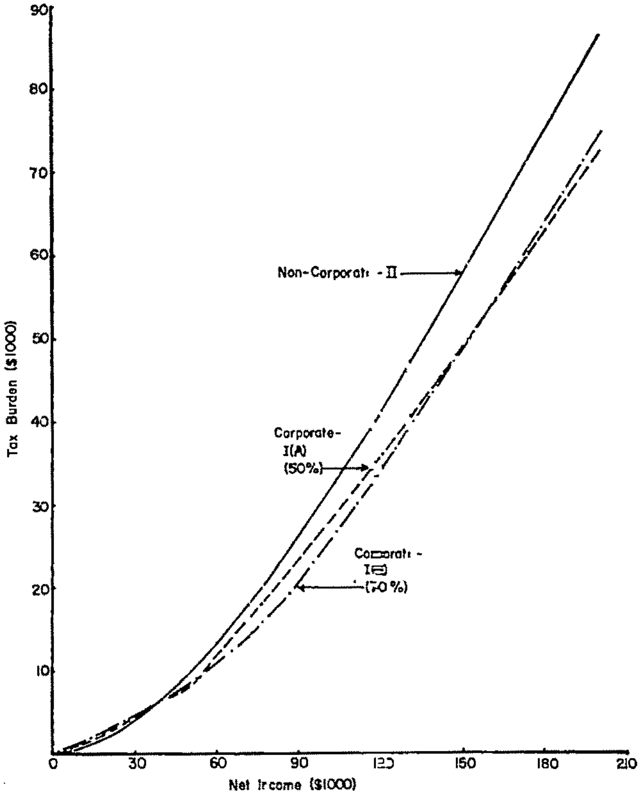

Figure 2. Total tax burden for firms ($10,000–$200,000)

mainder held for expansion under the corporate form of organization. Curve II reflects the tax burden under a non-corporate form of organization. It is assumed that each of the two individuals involved shares equally in salaries and ownership of the firm and that each claims four exemptions and the 10 percent standard deduction.

Impact of corporate income tax

Controversy has long raged over the incidence of the corporate income tax. It has been argued that the corporate income tax is in part an indirect tax insofar as it is passed on to the consumer and tends to raise the costs of goods and services and keep real wages lower than they might otherwise be [18, p. 20]. While this may be a reasonable hypothesis in imperfectly competitive industries where the corporation predominates as a form of organization, it is less persuasive in agriculture where the sole proprietorship predominates and where the impact of corporate firms on price is likely to be small. Alternatively, it has been argued that the corporate income tax is a direct tax on the shareholders and is unfair because it imposes a double tax on dividend income as compensation to equity capital before dividends are in spendable form [18, p. 20].

The relative burden of the corporate income tax varies, depending upon whether one is considering (1) saving capacity and incentives to invest, (2) systematic pressures for debt as opposed to equity financing, or (3) distortions of resource allocation over time.

Saving capacity and incentives to invest

Comparisons of corporate and individual tax rates are relevant for internal investment purposes to the extent that capital retained in the firm for expansion is subjected to differential rates of federal income tax. Quite clearly, at low income levels the individual taxpayer has the advantage; at high income levels, the corporate taxpayer is in a more favorable position as indicated in Figures 1 and 2.

In an effort to expand the benefits of the relatively favorable 22 percent rate on the first $25,000 of corporate taxable income, taxpayers have utilized multiple corporations, each complete with a separate income tax structure to place a 22 percent ceiling on taxable income. A number of provisions have been enacted to curb this practice.

After-tax capital for expansion from capital gains income, such as from the sale of breeding livestock held for 12 months or more, is substantially greater for an individual taxpayer who may deduct one-half of all long-term capital gains income. The other half is taxed as ordinary income. The maximum tax for any taxpayer on capital gains income under current law is 25 percent of the entire gain. Corporations, on the other hand, are not eligible for the 50 percent deduction and are taxed on capital gains income at 22 percent, if that is the relevant rate, or at 25 percent. The individual taxpayer, therefore, would normally not be taxed more heavily and usually would be taxed less heavily than a corporation.

Differential treatment of losses may also affect incentives to invest and expand. Individuals and corporations, under similar rules, may apply operating losses from a trade or business to income of the three prior years and may deduct from the succeeding five years' income any unabsorbed loss. A corporation may have no carryover if there has been a substantial change in the ownership of the corporation. However, where there has been no change in ownership of a corporation, past losses may be applied against income from new ventures under the same carryback and carryforward rules.

Corporations with excess capital losses may apply those losses against capital gains in the five succeeding taxable years. Individual taxpayers in contrast are allowed an unlimited carryforward period and may also offset up to $1,000 of ordinary income each year with excess capital losses. Again, the advantage rests with the individual taxpayer.

Any advantage of the corporation in terms of after-tax dollars for expansion from ordinary income must be tempered by application of the accumulated earnings tax which is peculiar to the corporation. The accumulated earnings tax is designed to prevent corporations from avoiding income tax at the shareholder level by accumulating income at the corporate level in excess of the reasonable needs of the business with ultimate distributions in liquidation at capital gains rates. A corporation accumulating more than $100,000 in earnings and profits is subject to the accumulated earnings tax (imposed at rates of 27.5 percent to 38.5 percent) unless it can be proven that the reasonable needs of the business require such accumulation and that tax avoidance at the shareholder level was not one of the reasons for accumulating earnings and profits.

Certain tax and non-tax reasons may encourage individual taxpayers to use the corporation not only to operate a business, but also to serve as the vehicle for making personal investments. One advantage of a corporate investor is that dividends received by a corporation from another domestic corporation are eligible for an 85 percent dividend received credit. At the lowest marginal rate, dividends received by corporations are taxed at a 3.3 percent rate (22 percent × 15 percent) compared to a 14 percent percent to 70 percent rate for dividends received by individuals, except for the $100 dividend exclusion. The personal holding company tax, which is designed to discourage such use of the corporation, is imposed at a 70 percent rate if 60 percent or more of "adjusted ordinary gross income" comes from passive investments and if five or fewer shareholders own more than 50 percent of the corporate stock. To the extent that the complex personal holding company rules can be avoided, a distinct capital accumulation advantage exists for the corporation.

For capital accumulation at the level of the individual, use of the corporation creates a double tax burden as dividends are paid out of after-tax dollars at the corporate level and are taxed to the shareholders as ordinary income upon receipt except for the $100 dividend exclusion. The double taxation aspect tends to encourage the expansion of existing successful corporations and intensifies their search for profitable investment opportunities as funds are retained at the corporate level.

Debt vs. equity financing

The income tax treatment of corporate inputs typically creates both internal and external manifestations with respect to the firm. Interest as compensation for debt capital, salaries and bonuses as compensation for labor and management, and rent as compensation for leased inputs are all tax deductible at the corporate level and taxable to the recipient as ordinary income. Dividends, however, as one means of compensation for equity capital, are not tax deductible at the corporate level and, as noted above, are taxable to the recipients except for the $100 dividend exclusion under federal income tax law. Therefore, an incentive exists for corporations to pay out earnings in tax deductible form, thus encouraging a skewing of the income distribution schedule in favor of higher levels of tax deductible payments where some measure of identity exists among the shareholder-creditor-employee groups. Only in Subchapter S corporations are dividends, interests, salaries, and rent treated substantially alike for tax purposes.

The tax advantages of interest payments compared with dividend declarations encourage the use of bonds, debentures, and notes in a corporate financial structure. Heavy use of debt financing may result in a "thin" corporation with a weakened balance sheet, high fixed rate interest payments that do not fluctuate with the earning power of the corporation, and Internal Revenue Service challenges to the debt securities as essentially additional classes of equity securities with disallowance of interest deductions.

Decision making subsequent to death of equity capital contributor

Under current law, death of a property owner produces a new income tax basis for most property. The basis becomes equal to fair market value as of the date of death (or as of the ultimate valuation date up to one year after death) with the potential gain in the property eliminated. This provision of the tax law has been criticized as an inequitable loophole favoring principally landowners and shareholders, and repeal has been suggested in recent years.

For a farm operated as a sole proprietorship, with the farmer owning the property personally, the rule has several effects on decision making. The new basis at death enables the successors to set up a new depreciation schedule after death even though the property had previously been fully depreciated. Upon sale of the property subsequent to death, the amount received would not be taxable up to the date-of-death value. The tax-saving incentive may be so great as to (1) discourage lifetime gifts of heavily appreciated property[8] and (2) encourage the placing of high values on property at death (with due consideration of marginal income tax rates and marginal death tax rates).

For farmers operating in corporate form, the effect of death of the equity capital contributor is substantially different. Upon death of a shareholder, the income tax basis of the stock becomes equal to fair market value with the potential gain in the stock eliminated. However, a shareholder death has no effect on the income tax basis of corporate property. Therefore, once corporate property is fully depreciated, no additional depreciation is claimable by virtue of death of a shareholder, even a shareholder owning all of the corporate stock. Similarly, all of the gain on corporate property is fully taxable upon sale of the corporation.

This differential effect by form of organization may be substantial in farm businesses where a farmer as a decedent typically owns heavily appreciated property. Tax reform proposals under consideration in the Congress in recent months would reduce the magnitude of this differential effect significantly.

Employee or self-employed status

The employee status accompanying corporate organization of large-scale farm firms typically poses both advantages and disadvantages compared with the self-employed status of sole proprietors. In most instances relatively more social security tax is paid, inasmuch as self-employed farmers pay tax (which is not income tax deductible) at a rate of 6.9 percent (for 1960–70) on the first $7,800 of earnings from self-employment. For a corporate employee, the tax is levied at a rate of 4.8 percent, with a like amount imposed on the corporation for a total of 9.6 percent. The difference, at the maximum income level, would be $210.60 per employee per year.[9] Moreover, while wages earned by a minor are not subject to social security tax if he works for his parent, his wages are subject to the tax if paid by a corporation.

Participation in various employee benefits is available only to employees and not to a sole proprietor or partner in a partnership. Group term life insurance, health and accident insurance, stock option, and deferred compensation benefits are available to eligible employees [11]. Of these benefits, only deferred compensation plans are available to the self-employed farmer and then on less advantageous terms.[10]

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[8] For property given away during life, the income tax basis for the gift property normally carries over, with the potential gain intact, to the recipient.

[9] The employer's share is income tax deductible, however.

One income tax advantage accompanying employee status relates to treatment of personal living expenses. Lodging and food costs, as personal expenses, are not deductible by a sole proprietor. However, meals and lodging furnished to an employee for the convenience of the employer are deductible by the employer and do not constitute taxable income to the employee. It has been argued, sometimes successfully, that farm employees may reasonably be required to accept lodging on the premises for the convenience of the employer and as a condition of employment, with the result that meals and lodging are provided tax-free.

Conclusions

Generalizations as to the differential effects of the legal and tax structure by size of farm firm are suspect; the variables are many, and the facts of each situation are unique and determinative. However, it appears on balance that the legal and tax structure does not discriminate systematically against small-scale farmers and for large-scale firms. Rather, numerous instances have been cited where the smaller-scale farmer qualifies for special treatment and escapes limitations imposed directly or indirectly upon large-scale firms. The major advantage of the large scale corporate firm in reporting taxable income at a maximum of 48 percent could scarcely be considered an advantage when compared with the lesser rate for many individual farmers. However, the corporate tax structure does provide strong encouragement for corporate operation by high-tax-bracket individuals. The tax advantages of employee status are available to employees of sole proprietors and partnerships but not to sole proprietors themselves and generally not to partners.

While it is not surprising that state and federal laws do not discriminate in favor of large-scale farm firms, a relevant policy question is whether state and federal laws should discriminate to a greater extent in favor of small-scale farm firms or whether a position approaching neutrality should be sought.

Whether large-scale firms engaged in farming have advantages not available to large-scale firms in other sectors was not fully examined in this paper. If in fact such advantages exist, and there is some evidence of such advantages,[11] large-scale firms may be encouraged to enter farming even though operating under a somewhat less advantageous structure than small-scale farm firms. Economies or diseconomies of size may be important, however, and may dwarf differential legal and tax effects.

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[10] For example, up to 15 percent of employees' compensation may be set aside in a qualified profit-sharing trust, whereas only 10 percent of earned income (maximum of $2500) may be set aside under the Self-Employed Individuals Tax Retirement Act.

[11] See footnote 2.

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Legal-Economic Models as a Tool for Optimizing Intergeneration Property Transfers*

DONALD R. LEVI AND JAMES K. ALLWOOD

THE trend to larger agricultural production units, together with inflation, has increased both the net value of the typical farm family estate and the resulting death tax liability.[1] Since the minimum estate size to which federal estate taxes apply[2] has not changed over time, more farm estates are now subject to this tax. But many farmers are unaware of the law or the extent of capital erosion accompanying intergeneration property transfers. This erosion often can be significantly reduced without sacrificing current consumption. Thus the rational manager can no longer afford to ignore legal rules affecting intergeneration transfer costs.

The magnitude of capital erosion through federal gift and estate taxes was illustrated by Allwood [1, p. 85] for five estates ranging in value from approximately $225,000 to $1,800,000. Assuming a family of five in which the 58-year-old husband and 56-year-old wife lived normal life expectancies, he found differences in transfer costs between optimal planning and no planning ranging from approximately $36,000 to nearly $456,000.

However, benefits from estate planning include factors other than intergeneration transfer cost minimization. Some insight to these is revealed when one considers the basic objectives of estate planning, as follows:

1. To provide adequate security for retirement.
2. To assure each asset is transferred to those of the owner's choice.
3. To minimize intergeneration transfer costs, consistent with achieving the above objectives.

The relative importance of these objectives may vary among estate owners, depending on the nature, extent, and value of assets, the availability of other funds for retirement, the vocational preferences and equitable treatment of heirs, consumption patterns and needs, personal preferences and other factors. Since different individuals attach differing

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[1] For a general discussion of this phenomenon and some empirical estimates of the effect of death taxes, see [2].

[2] The absolute minimum are $60,000 for single persons and $120,000 for married couples (assuming optimal planning for the latter).

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weights to these items, it becomes apparent that personal satisfaction, a factor not readily susceptible to quantification, is the criterion estate planners implicitly seek to maximize.

Previous Work

Conceptualization

While Schulz [9] suggested roles for economists in estate planning, the conceptualization of using legal-economic models to optimize intergeneration farm property transfers appears to have been an outgrowth of Harl's dissertation [3]. His envisioned use of the model developed therein was as follows:

> At a less theoretical level, some sections of the model may, with suitable modification, be utilized in professional disciplinary practice. Thus, the portion of the simulation model representing the personal estates of owners of the firm may be adaptable for use in estate planning. At relatively low cost and extreme rapidity, a vast amount of data could be generated for professional evaluation based upon the application of alternative estate plans to a particular set of estate planning data provided by a client. Similarly, the decision-making precision as to choice of form of business organization for a client could be improved by applying, statically or dynamically, the various formulations of the models to a client's factual situation [4, p. 100].

To summarize, the purpose of such a model, whether deterministic or nondeterministic, would be to provide the client with more and better information upon which to base decisions. It should not be expected to yield a plan to be blindly followed.

Multi-period linear programming model

Harrison [5, 6] appears to be the first in the profession to develop a model specifically designed for use in estate planning. He used a multiperiod linear programming model maximizing the undiscounted value of property transferred equally to four heirs by a widow with a five-year planning horizon. The model considered inflation, earning capacity of assets, the widow's consumption requirements, and benefits from social security, medicare, and a medical insurance program.

Since gifts made within three years of death may be subject to federal estate tax on the theory they were made in "contemplation of death,"[3] Harrison actually used a two-year effective planning horizon. While it can be argued that manual calculations of gift tax exemptions and exclusions is more efficient than using the computer for this length of planning horizon, it should be noted that his model can readily be expanded to longer planning periods. Harrison's model also envisions planning to be initiated after one of the spouses has passed away. While unfortunately this often is the sequence of events in reality, it would not necessarily maximize property transferred to the succeeding generation.

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[3] Under section 2035 of the Internal Revenue Code, any such gift is presumed to have been made in contemplation of death and will be subject to federal estate taxes unless this presumption is rebutted.

A static linear programming model

Allwood [1] developed a static linear programming model with the objective function of minimizing the summation of federal gift and federal estate taxes[4] associated with the intergeneration transfer of assets from both spouses. He assumed an equal division among three children whose parents had, respectively, 17- and 22-year planning horizons. The model was designed to select the optimal transfer activities from among seven alternatives (see Figure 1). Allwood assumed that consumption would not exceed asset earning capacity plus social security benefits and that assets would not change in value over the planning period.[5] Thus, neither his model nor that of Harrison included all relevant estate management factors for the typical farm family.

The potential use of deterministic estate planning models

Deterministic estate planning models can be criticized as assuming certainty not existing in the "real world." However, estate planners implicitly use a deterministic "model" when developing an estate plan, with the form of such plan reflecting the assumptions regarding the client's personal circumstances. A formal model merely makes these assumptions explicit. Thus, the validity of the aforenoted criticism is dependent on the expected contribution of the particular legal-economic model. The criticism may well be valid if one expects the model to outline a plan that yields optimal results in all cases.

To avert some of the problems of risk and uncertainty, such factors as a probability density function for life expectancies could be utilized in the models, although knowledge of a given client's health might be of greater benefit to estate planners in many cases. Potential but unpredictable (or at least unpredicted) changes in external factors, such as the general price level, may mean that the model would yield varying cost minimization strategies if computed at different points in time. Thus, the irreversibility of certain strategies (e.g., sale) should be recognized, and alternative courses of action and their associated costs carefully investigated.

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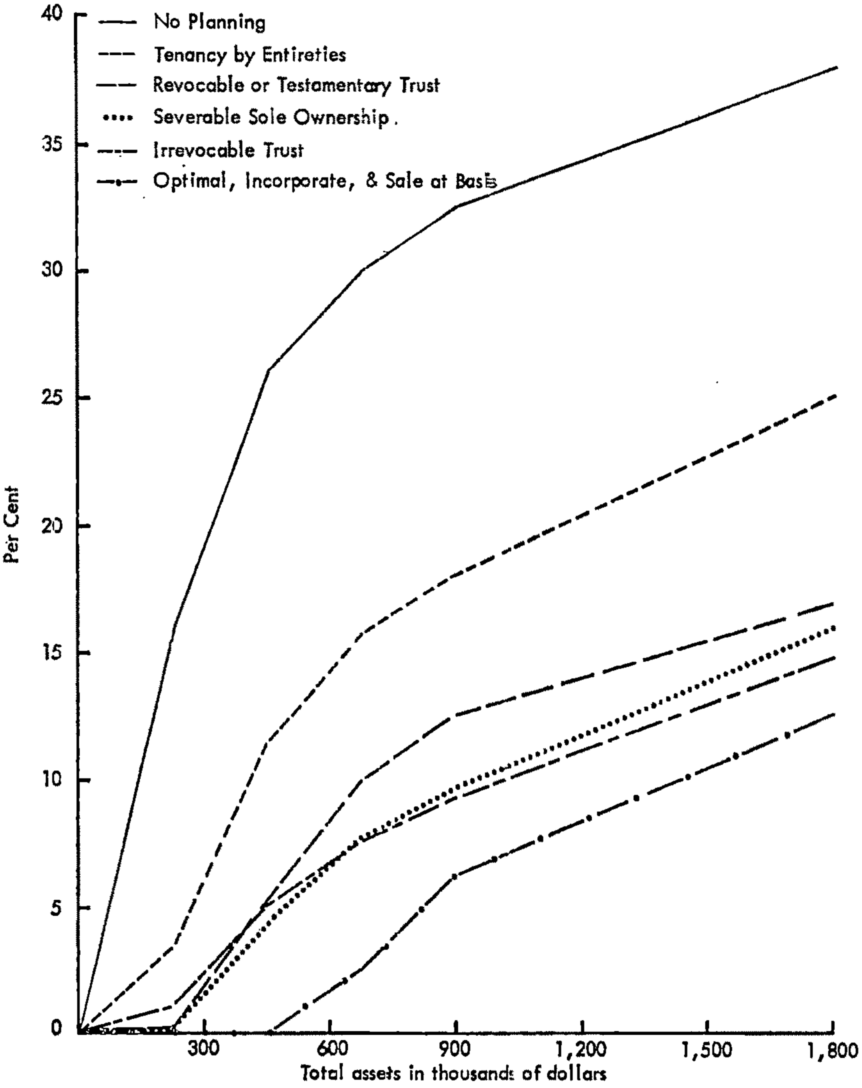
[4] Depending on estate size, I.R.C. 2011 permits varying amounts of state death taxes paid to be subtracted as a credit from the federal estate tax due. When such state death taxes are less than the allowable credit, many states assess an additional tax in the amount of the difference (e.g., see R.S.Mo. Ch. 145.070 (1959)). Under this situation, the magnitude of state death taxes will not affect intergeneration transfer costs, permitting them to be excluded from the objective function.

[5] The former may have been justified, given the estates examined. The latter is somewhat unrealistic, although often used in practice by estate planners.

Figure 1. Total tax as percent of total assets of husband and wife, optimal and forced solutions



Allwood's work indicates that a deterministic model can provide information not generally known to estate planners. While his model selected sale of the family farm at market value (to a son interested in farming) as the optimal strategy [1, p 82], cost data were obtained for comparative purposes by successively forcing the other six activities into the solution. Figure 1 shows these activities and the cost associated with each as an estate increased in value from approximately $225,000 to slightly more than $1,300,000. In addition to illustrating the significant savings that can be achieved by proper planning, Figure 1 also shows how the relative costs of various transfer activities change as the estate increases in value.[6] Many estate planners may be unaware of these changes, and few would be likely to know the exact level at which they occur. Thus, such a model could provide helpful information in this regard.

Potential Models and Extension

The effectiveness of any legal-economic estate planning model can be evaluated only after specifying both the purpose for which it is to be used and the estate owner's personal planning objectives. The authors tend to believe models providing estate planners with more and better information are likely to be adapted in practice, as implicitly suggested by Harl. For some, a relatively simple model may suffice.

Marginal analysis-opportunity cost models

For those whose estates are not large enough to be subject to federal estate taxes, retirement security may often be the major estate planning objective.[7] To this end, depending on the length of the planning horizon, a simple opportunity cost model involving alternative investment opportunities, income flows, anticipated social security and medicare benefits, and other factors may meet the need for assistance. However, a more sophisticated approach may be required if the estate is large or if the planning horizon encompasses more than one intergeneration transfer.

Linear programming

Either Allwood's static or Harrison's multi-period linear programming model could, with appropriate modification, be adapted for practical usage. Such a model might include specific allowances for inflation, asset earning capacity, consumption requirements, social security, medicare, and medical insurance benefits, and could permit election of optimal transfer activities in light of the circumstances of both spouses among various alternatives. Other factors, such as a Keogh retirement plan and credit needed for growth might also be included. Such models might be either deterministic or probabilistic if probability distributions are incorporated for such factors as life expectancy, income flows, etc., in the manner of Johnson et al.[7].

Simulation

The potential use of simulation to link theoretical models with reality is well known. It might have two distinct uses with regard to estate planning. First, several computer runs could be made to provide intergeneration transfer cost information for alternative strategies or for such factors as the order of death within the family, while making deterministic assumptions with respect to such conditions as the length of the planning horizon. Estate owners could then evaluate this information in light of family circumstances and objectives and select the transfer activities that maximize personal satisfaction.

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[6] For an explanation of why such changes occurred, see [8, p. 279].

[7] For a discussion and examination of achieving such security by participating in Keogh retirement plans for self-employed persons, see [10].

Second, the technique could be used in conjunction with a probability density function for life expectancies to generate the probability distribution of costs associated with a given policy. This, together with the cost information generated and knowledge of the health conditions of the various parties, could greatly aid in the selection of the appropriate transfer activities.

The fact that such models are quite complex would of course be considered a disadvantage if a unique model had to be developed for each estate owner. However, once a simulation model capable of general usage is developed, complexity would be important only to the extent that it increased the cost of generating the desired information.

Concluding Comment

This paper has merely scratched the surface in discussing the potential use of legal-economic models as a tool in estate planning. The field is wide open, limited only by the ingenuity of the researcher.

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Discussion: Agriculture and the Law

THOMAS F. HADY

Heaven, for a discussant, might be defined as a group of papers in which there are errors of fact and logic with which he can loudly disagree. In these papers, however, I have not found this kind of heaven; I find nothing of consequence to correct. All of the authors have done a thoroughly professional job on their papers.

Since I see little to quarrel with, perhaps the most useful thing I can do is to look at the same subject matter from the standpoint of a set of interests slightly different from those of the authors and try to discuss further some of the same points that seem to me particularly important.

A recurring point in the Krausz and Reiss paper is the problem of finding an equitable distribution of costs and revenues. Two related topics are involved here: equity, or some sense of what people in general think is fair; and efficiency, as economists define it. Our society as a whole appears to consider it equitable that people be compensated in proportion to the value in production of the resources they own (with strong reservations, however, in the case of the poor). When the same individual owns all the resources used on the farm, errors in the compensation of each factor cancel out and do not affect equity. This is not true, however, when someone else owns some of the resources. It seems to me that the point Krausz and Reiss are making is that the growing number of instances in which the bundle of resources used in farming are owned by different people has made it much more important that these people know the "value"—the marginal productivity—of their inputs. It provides a further incentive, if we ever needed one, to help farmers and other resource owners to obtain better management data and to make better decisions.

The economic efficiency problem seems to me more difficult. At least since Adam Smith and his "invisible hand," economists have relied on the market to provide an optimal distribution of resources in production. We know more about the conditions under which this optimum will be produced than Adam Smith did, but we have not, by and large, deviated from the principle. The availability of institutions to combine inputs owned by different individuals may remove some institutional barriers which otherwise would have prevented an optimal combination of factors of production in farming. The fact, however, that these inputs are owned by different people should not, in itself, affect efficiency. A farm with given quantities of land, labor, capital, and entrepreneurship is the same

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productive unit whether those inputs are owned by one person or by several. Further, imperfect information about marginal-value-products seems no more likely to produce misallocations of resources whether the resources are owned by one person or several. Market imperfection in the form of elements of monopoly or monopsony in the factor markets are another story. We may need to take a closer look at the effects on economic efficiency of the new structure of factor markets in agriculture.

Krausz and Reiss also raise the question of the exemptions from the death tax and appear to suggest, as others have suggested, that these exemptions are too low; death taxes may be interfering with intergenerational transfers of farms. Unquestionably, there are operating units for which this is true. (One of the reasons for which death taxes have been advocated is to prevent large accumulations of individual wealth.) Based on some preliminary spadework a few years ago [1], I remain skeptical that this is a serious problem for the typical farmer. The important point, however, is that this is a question on which researchers could provide much more information than they have provided. For farms of various types, sizes, and ownership patterns, what would the death taxes be under careful estate management? Would borrowing that amount impose particular hardships on the heirs? Would the fact that they were forced to borrow affect the long-run growth of the farm firm in any foreseeable ways, and, if so, how? What effects will death taxes on farms have on the economy as a whole, and do those who inherit farms experience problems that other heirs do not? Researchers trained in agricultural economics and in law have provided a real service in producing bulletins to help farmers with estate planning (and Krausz is a coauthor of one of the best of those bulletins). Now we should go the next step and make an effort to find out what the effects of these laws really are.

Levi and Allwood have provided a start in that direction, with their discussion of legal-economic models. Their discussion seems to be directed primarily, however, at the legal-economic model as a tool for estate planners. I would suggest that these models are likely to be of much more immediate use to those who are interested in the effects of various changes in public policies and laws—the sort of changes Krausz and Reiss discuss. I would suggest that designers of these types of models consider this use specifically and design the models so that tax rates, exemptions, and other legal provisions can be varied. Then we shall need to work out means of better evaluating the effects on the economy of the conclusions we draw from those legal-economic models. Perhaps we are working toward the day when we can weld these models together with models of agricultural production, such as those being developed in ERS, and models of the overall economy and simulate the answers to questions such as the economic effects of changing the exemptions on the death tax. I hasten to add, however, that we will not then have designed a computer system for writing our laws. We still do not know how to define, let alone build models of such concepts as equity. I must also confess to some lingering doubts as to whether this type of "building models" is the best way to attack these research problems.

Harl's paper gives us a good discussion of the legal advantages and disadvantages of large-scale farming. The shortage of economic analysis of the effects of these laws is not Harl's fault; the research has not been done. Further, I have become increasingly convinced that if we are to understand the impact of tax provisions and similar laws on the structure of American agriculture, we are going to have to change some of our fundamental habits in agricultural economics research.

Traditionally, we have devoted most of our efforts to studying the "typical" family farm. This farm does not seem to be the place to study impacts of tax laws on the structure of agriculture. These effects seem to show up in the "atypical" farms—the very large farms and those that are integrated in some fashion with other, nonfarm businesses. We appear to know very little about these farms. We hear that a corporation in some unrelated industry like trucking has bought a large farm, but we have no notion of what made the farm attractive to it. Perhaps we need, for a start, some case studies of situations of this type, designed to give us a better understanding of the ways in which farms fit into a conglomerate business structure.

These studies will require a new set of skills. It seems doubtful that many of the firms will give us access to their records, in the same way that the typical farmer does when he answers a questionnaire. Perhaps we can borrow some tools from economists who have specialized in problems of business structure and monopoly. We shall also have to forge some new tools of our own. However we do the job, it remains a job that needs to be done.

I think we can agree that these papers have made important contributions to a subject that has been neglected for too long. Let us hope that this neglect will not continue.

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INDUCING ECONOMIC DEVELOPMENT IN LESS DEVELOPED COUNTRIES

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Foreign Aid for Agricultural Development: Philosophy and Implementation

JAMES GILBERT EVANS, SR.

ACCORDING to a definition carefully selected from a Webster dictionary, "Philosophy investigates the most general facts and principles of reality and of human nature and conduct . . . it is concerned with evaluation."

The Human Condition—Present and Prospective

A philosopher once wrote that "men build their cultures by huddling together, nervously loquacious, at the edge of an abyss." The current abyss is the threatened depth of chaos into which mankind may fall unless people are enabled to share more fully and equitably in the benefits flowing from the application of science and the use of inanimate energy. Presently, of a world population of nearly 3.5 billion, about 2.5 billion live close to the level of subsistence; only a billion live above this level; a few, far above it.

We become even more nervous and more loquacious when we contemplate that an additional 3 billion inhabitants will be on the scene within four decades. After several million years, a billion human beings inhabited this earth by 1810, two billion by 1925, and three billion by 1960. Apparently there will be four billion by 1980, five by 1993, and six shortly after 2000, if not before. A median estimate for the year 2000 places the death rate in the world at 9 per thousand and the birth rate at 25, leaving a natural increase of 16. At present, the natural increase is approximately 18 per thousand [20]. A reasonably stable world population cannot, therefore, be achieved for at least another half century, even assuming tremendous and successful efforts to reduce the birth rate. By that time, the human inhabitants of spaceship earth may easily number 8 billion.

Out of a probable world population of 6.2 billion in the year 2000, Asia will have 3.5 billion, more than half the total and almost double its present number; Latin America, 640 million; and Africa, 770 million—each

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more than double its present number. Combined, these continents will have nearly 5 billion of the world's 6.2 billion. Europe, Northern America, and Oceania, with but 1.2 billion, will become a relatively small pebble on the world population beach [13].

Per capita income in mid-1968 in Asia was estimated to be approximately the equivalent of $128; in Africa, $123; and in Latin America, $344. The per capita income in agriculture on all three continents is well below the average. The more populous Asian and African countries have per capita incomes under $100. Per capita income in Northern and Western Europe is above $1,500, while in Northern America it is above $2,700 [13].

Gaps in the human condition are also extreme within national societies. In India, for example, the richest fifth of the population receives at least one-half of the total national income, while the poorest 20 percent gets about 5 percent. The richest two-fifths receives 70 percent and the poorest three-fifths only 30 percent [10, App. 14]. Some of the high per capita income countries do only slightly better. In the United States the richest fifth of the families have about 44 percent of the national income while the poorest fifth get less than 5 percent. The richest two-fifths get 68 percent and the poorest three-fifths get 32 percent of the national income [22].

Although per capita income is only a rough approximation of living levels, there is no doubt that social conditions in the low income countries are more deficient than in higher income countries. Life expectancy is lower; infant mortality is higher; illiteracy is greater; a lower percentage of school age children is in school; nutritional deficiency is more severe; and housing, clothing, and recreation more inadequate. To this huddle of agriculturists, the abyss must seem especially wide and deep because families working in agriculture around the world probably comprise at least two-thirds of those living close to subsistence.

Empathy for our fellowmen and awareness of the potential of available scientific knowledge have led to the belief, rather widely held in the high income countries, that these "extremes of poverty which shorten, cripple, and undermine the values of human life" can be removed. Those living close to subsistence are also aware of the possible benefits from advances in technology and have come to expect a better life for themselves and certainly for their children. Over the years, these expectations will surely rise higher and higher.

Development Goals and Strategy

Increases in per capita income, total output of goods and services, gross national product, or the rate of economic growth are customarily regarded as evidence of development. It is one of the great ironies of our time that these "economic indicators have become so much a part of our thinking that we have tended to equate a rising national income with national well-being" [22]. They are neither acceptable measures nor the Holy Grail of development. Talk of closing the per capita income gap between affluent and poor countries is both naive and unfortunate. It is naive because this gap will surely widen in the decades ahead, considering relative population growth and relative capacity for advance in technology. It is unfortunate because whether the gap widens or narrows is no concern of the poor countries, and it diverts attention and resources from the highest priority goals. What is important and what can be achieved is provision for adequate nutrition, medical services, education, employment, and recreational opportunity.

Chief S. O. Adebo of Nigeria appraises the situation with realism: "Most people speak of bridging the gap between the poor and affluent countries. I prefer myself to put it differently. I see the problem as one of securing a decent standard of life to the millions of people condemned to live below the subsistence level and the millions who do only slightly better. For these people the question is not one of affluence, it is one of survival" [1].

Latin American countries participating in the Alliance for Progress have agreed to work toward the achievement of maximum well-being "with equal opportunity for all" and to make "the benefits of economic progress available to all citizens of all economic and social groups, through a more equitable distribution of national income, raising more rapidly the income and standard of living of the needier sectors of the population."

The late T. J. Mboya, in presenting the development plan for the years 1966-70 to the people of Kenya, stated that "the aims of the government are clear, to achieve high and growing per capita incomes, equitably distributed, so that all are free from want, disease and exploitation, while at the same time ensuring and guaranteeing political equality . . . social justice, human dignity . . . and equal opportunities . . ." [7]. Unfortunately, higher per capita incomes are not automatically distributed equitably and do not necessarily free those at the bottom of the human heap from want, disease, and exploitation. Belatedly, the Pakistan Government Planning Commission discovered that "growth is not an end in itself, it must be accompanied by social justice" [4].

No nation can point with pride to an increase in per capita income unless such an increase is reflected in the level of living of the poorest half or two-thirds of its citizens. *Development occurs when resources are allocated to produce the goods and services essential to human well-being in increasing quantities and when the people in greatest need are able to obtain and consume them. Agricultural development occurs when the quantity and quality of resources are being improved and combined effectively* *to maximize output and when the institutional environment is being modified to insure that the output is used directly and indirectly for the well-being of cultivator families.*

A United Nations report on transformation of the agrarian structure concludes "that far greater effort should be devoted than has been applied so far to economic and social development in the neglected rural areas where most of the population lives and will continue to live for decades to come" [19]. Transformation of the agrarian structure has so far been slight indeed. André Postel-Vinay of France considers the major error in the thinking and direction of development efforts to have been their "inadequacy in improving the standard of living of the rural population" [18]. This error has resulted from a failure to recognize that *dealing directly with poverty, malnutrition, exodus to cities, growth of slums, and unemployment has the highest priority in development policies and programs.*

How the Level of Living of Cultivator Families can be Improved

One of the most powerful institutions accounting for inequity in the distribution of well-being in agriculture is the land tenure system, "which defines social class relations more than does any other institution in most of the world's agrarian countries, controlling or at least limiting the power of choice and action of individuals and families, rationing economic opportunity and determining the inter-personal distribution of production and income and the extent to which economic incentives become meaningful to farm people" [21]. There is wide variation in land tenure systems ranging from plantations and large farms with hired labor, through sharecropping and other forms of tenancy, to cultivator ownership. A tenancy system prevails in most of the low income countries. Landless laborers are numerous and generally receive no more than a subsistence wage [15]. Until these conditions are changed, cultivator families will continue to live close to the subsistence level. Furthermore, agriculture cannot absorb the prospective increase in the rural labor force without worsening the well-being of farm people. Some additional land can be brought under cultivation in Africa and Latin America, but such expansion would not take care of the major portion of those needing employment.

Two lines of action are required to raise the level of living of cultivator families above subsistence: First, they must share in farm land and capital income, because a rapidly expanding labor force seeking employment will keep labor income from rising significantly; and second, non-farm employment opportunities must be created that are at least commensurate with population growth.

The need for land income to supplement labor income and provide other benefits to cultivators can be met only under appropriate land tenure and tax policies. Cultivator ownership of land or cultivator sharing of land income under cooperative or other institutional arrangements is therefore imperative, together with provision for taxation to support adequate educational health, and other services. There are, of course, no model land tenure or tax systems for universal adoption.

Already it is obvious that the towns and cities in the poor countries are not providing employment opportunities to those who come from the farms and rural areas in increasing numbers and there is no prospect that they will do so in the future. Even now cities in Latin America, Asia, and Africa have become "cancerous growths," in spite of their modern appearance.

We have become loquacious about the urgency of growing more food and the imminence of famine in view of the population explosion, and properly so. Yet, considering the breakthroughs in food production, nutrition requirements can probably be met even for 8 billion people. If famine occurs, it will be either because resources are not being allocated for the production of enough food or because those who are starving cannot get it, although a supply may be close at hand. Today there is hunger and malnutrition in areas where food is abundant, but employment and purchasing power are absent.

A most general basic fact of reality is that for the next half century *the greatest challenge facing the technologically less-developed countries will be the creation of employment opportunities, largely in rural areas, through establishing relatively small-scale labor-intensive industries for processing agricultural products and inputs and for manufacturing consumer goods for rural people.*

According to McRobie, ". . . it is in the rural areas and small towns of developing countries that an appropriate technological base must be built up. . . The essence of the task is to provide the rural areas with technologies which are more productive, more useful for controlling the environment without making them too expensive and sophisticated to be out of reach of the great majority of the population. One of the essential characteristics of such technologies would be that they are widely reproducible from indigenous resources. . ." [8].

Dependence on spontaneous individual action to create employment opportunities on the vast scale required is not feasible; national governments necessarily have this responsibility, possibly using some type of development corporation that would promote the spread of electric power to villages and the formation of small-scale labor-intensive processing and manufacturing plants. Although the production units will vary in scale, they will generally be small, but the organization for establishing them and providing for their overall management and coordination must be large scale. Development is a deliberately directed process, managed by a government with broad functions and responsibilities and powerful enough to plan and execute its policies and programs. There is no formula or standard pattern for development that fits all societies; each society must invent new political and economic structures and management techniques to meet its special needs.

Technological underdevelopment in agriculture means that the labor force is poorly educated, largely unskilled, badly housed, and has a high incidence of disease and malnutrition; furthermore, little inanimate power is used, which limits tools and machines to those requring only animal and human muscle for their operation.

There are thus two inseparable aspects of technology—two sides of a coin: One consists of educated and skilled people; the other, the tools, machines, and inanimate power, transportation, and other facilities that people design, operate, and use. Therefore, basic to technological improvement in rural areas is elementary education. As Peaslee has pointed out, ". . . in the last hundred years significant economic growth has been achieved only in those countries in which a high proportion of the total population is found in primary schools. . . . After primary enrollments have become high in the more economically successful countries, the emphasis on education has been shifted onward to the secondary and higher education levels" [11]. Universal compulsory elementary education is especially important in the less-developed countries because it makes possible a fuller utilization of human resources. Preparing children for nonfarm employment has high priority, even though more than 15 percent of the total population would be in elementary schools.

That "the technological revolution spreads in inverse proportion to institutional resistance" is a most general principle of reality [2]. Presumably, the higher the education level in a society, the greater the prospect that the "crust of custom" can be broken and institutions modified. An educated people will surely be more responsive to the need for smaller families. People must change before institutions and customs can be changed.

Small farms, which predominate in the low income countries, reflect a combination of land, labor, and capital resources dictated by the technology and institutions inherited from past centuries. With the quality and capacity of human resources being raised through various types of education, a different combination is possible even though the amount of land in each farm cannot be increased. The only feasible way to increase the productivity of cultivators is to adapt improved practices, techniques, and institutional structures to small farms. This appears to have been rather successfully accomplished in Japan. Cultivators own their farms; are primary school graduates; have been able to make use of modern science and inanimate energy; and have the benefit of an institutional structure, largely cooperative, which enhances and protects their economic position. Japan has also succeeded in providing off-farm employment opportunities to cultivator families, which is a source of more than one-third of their average income [5, 23]. While Japanese experience and institutional structure cannot be exactly duplicated in any of the developing countries, they indicate that cultivators can be served and protected in obtaining inputs and credit and in marketing crops and that small farms are not necessarily a roadblock to a better life for cultivator families.

Foreign Aid, National Interests, and Agricultural Development

That words are used to mislead and cover up is a most general fact of reality. It is reported that the most difficult problem of the Pearson Commission on International Development is in reaching agreement on the "objectives of aid policies of the donor countries," which includes "the very difficult problem of defining aid," and the examination of the assertion that "aid has been largely irrelevant to growth" [16].

So-called "aid" for development is provided by so-called "donors" to so-called "recipients." Neither aid nor donor nor recipient properly describes what is going on. Perhaps it would be appropriate to refer to aid as involvement of the more developed countries in the economic, political, military, and social sectors of less-developed countries, either directly or through international agencies.

Donors may be foreign governments, corporations, individuals, international organizations or private foundations. Aid may be people serving as actual workers or as advisors endeavoring to transplant knowledge, techniques, and institutions, or it may take the form of commodities, tools, and machines. These items may be provided as gifts, loans, or investments. Loans and investments comprise the great bulk of aid.

What are the objectives of the "aid policies of the donors?" They are a mixed bag, mainly economic and political with a dash of the humanitarian. One of the most general facts of human nature and conduct is a "tendency to assume that things which are associated in the society we know must necessarily be associated in all other societies" [6]. Perhaps it is perceptive to observe that our aid is "rooted in a concern for foreign societies *not as they are but as they might be reformed and reconstructed according to our own values and experience*" [12].

Noting that what we call private enterprise has been associated with our phenomenal technological advance and economic growth, we conclude that all other societies should have it, consequently restricting to the minimum the functions and responsibilities of their governments. Noting further that these low income countries do not have comparable quantities of inanimate energy, machines, factories, transportation, and other facilities found in the technologically advanced countries, we conclude that what they need are large injections of capital obtained through foreign loans and investments. A United Nations Panel on Foreign Investments in Developing Countries, meeting in Amsterdam in February 1969, called for a massive increase in the flow of foreign capital to developing countries in order to provide a reasonable rate of per capita growth [17]. These conclusions, though they may be false, have been accepted more or less voluntarily by many of the developing countries, resulting in heavy obligations not only to foreign governments and international lending agencies, but also to private investors who have acquired the privilege of exploiting mineral, forest and land resources to produce commodities for export and the privilege of building electric power, communication and transportation facilities, and industrial plants. In this way the donors promote their own exports, obtain raw materials and make very substantial profits. These operations are assumed to be in the national interest both of the donors and the recipients. What is good for the donors must be good for the recipients! This concept of the national interest rests on the further assumption that "the way to a better living for the people of all nations is in the direction of integrating their economies with those of other countries so that they can maximize their access to the markets and resources of the world" [3].

These assumptions may also be false, depending on the connotation of national interest. Is the greater national interest of the American people best served by lending and investing abroad or by using the resources involved to rebuild their cities? Is the greater national interest of the people of a less-developed country served by having foreign investors exploit their natural resources and build their industries before they have the capacity to do this by themselves? Will the poor economies be able to protect their interests when they are integrated with the more affluent economies? Unequivocal answers to these questions are not readily available.

The governments of the more developed countries, in order to protect their foreign loans and the investments of their citizens, help recipient governments to stay in power by strengthening their military and police forces. This arrangement leaves the large landowners, the military, the industrial and mining interests, the traders, and the government bureaucracy in firm control of a country. Any change, social, economic, or political, which threatens this power structure is deemed "subversive" and dealt with accordingly. Should a government come into power that attempts significant reforms, there is always a military coup at hand to remove it from the scene.

As a consequence of a mutuality of interest between the dominant power groups in the donor and recipient countries, substantial aid and indigenous resources have been used for construction of luxury hotels, apartments,and office buildings, and for obtaining luxury consumer goods and services, as well as for the exploitation of mineral resources and the establishment of capital intensive industries. In agriculture, the more affluent landowners have been the first to obtain the benefits accruing from the introduction of the high yielding varieties of rice and wheat.

However, foreign aid has undeniably contributed substantially to present and potential progress in some sectors of the economies of the recipient countries, including the agricultural sector. Most of the infrastructure projects, such as roads, dams, electric power generating and transmission facilities, and some of the education programs, such as the strengthening of medical, agricultural and public administration schools, have furnished a foundation for future economic and social progress.

Nevertheless, certain major aspects of foreign aid have helped create conditions that give little promise to dealing effectively with the need to advance a technology suited to small farms and with the need to create non-farm employment opportunities for a rapidly growing rural labor force. Insofar as aid is responsible for maintaining governments in power that are unwilling to carry through meaningful land tenure reforms or to devise a tax system which provides sufficient revenue to support really adequate education and health programs or to accept responsibility for the creation of sufficient employment opportunities in rural areas, then aid has been inimical to agricultural development.

Insofar as aid has contributed to an emphasis on the expansion of capital intensive industry in urban areas and has given priority to the larger landowners in programs to increase the output of food and export products, it has served to create islands of affluence, leaving the bulk of the people still with a traditional technology and at a subsistence level of well-being. A country with a dual society of this nature can never build a domestic consumption base to insure a full realization of its technological potential, either in agriculture or in industry. It leaves a major portion of its human resources untapped. Unfortunately, nearly every less-developed country is well on the way toward having a society in which those now at subsistence levels may remain there indefinitely while a small affluent segment will have all the advantages of both modern technology and feudalism.

There has apparently been massive lending and investment motivated by political and profit considerations, with too little attention paid to the prospective capacity of the recipients to earn foreign exchange. Already many recipients are experiencing difficulty in meeting debt and profit service. These difficulties will be compounded, should the "donors" succeed in their present efforts to induce a further massive expansion of lending and investing. Within a very few years the number of recipients unable to earn sufficient foreign exchange to meet foreign obligations will surely rise. Moratoriums and renegotiations will become habitual. Recipient currencies will be depreciated in relation to donor currencies. Official devaluations will become even more frequent.

Rising pressures to produce for export will distort the allocation of resources in agriculture, causing production to increase regardless of export prices. The terms of trade will worsen for the recipient, making still greater production for export imperative. More and more resources, which might have been used to produce for domestic consumption, must be allocated to produce for export as debt and profit service requirements grow. Food production may have to be sacrificed to produce exportable products. Existing land tenure systems will remain entrenched because they will most effectively produce surpluses for export.

Unless there are drastic changes in the concept and direction of foreign aid and in the strategy for achieving goals in the developing nations, the level of living of cultivator families will not be much improved.

It is intriguing to contemplate what might have happened if these poor countries with colonial and feudal backgrounds had been permitted to exercise a greater measure of responsibility for the development of their respective societies without external intervention, or, indeed, what could happen even yet if they should go more on their own.

A very minimal amount of loans and investments and a very minimal number of "technicians" from external sources would best serve the national interest of these countries. In discussing the contribution of aid to development, Mikesell concludes that "as a general proposition, external capital or aid is neither a necessary nor a sufficient condition for development. . . . By and large countries that are not making satisfactory progress, regardless of their per capita income, have failed to realize the potential returns from their own resources. What is required are policies and programs for mobilizing, adapting and reallocating those resources, including the training of human resources for the operations of a modern economy" [9].

There is also the principle of self-reliance and national pride in accomplishment. This principle has been sadly neglected. As Professor Brahamanand Prasad of Patna University has observed, "India has, at present, in the country capable engineers and technologists, trained both abroad and within the country, who could safely be entrusted to take up the work of development. In fact, a large part of this talent is either idle or underutilized. . . . It can be said that foreign collaborators and technology have exerted a depressing influence on the growth of self-reliance" [14].

The foreign aid needed by a developing nation is the kind that would enable its citizens to utilize their own natural resources, accumulate their own capital, and operate their own economy by themselves and for themselves exclusively, even though the process would be gradual over a considerable period of time.

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Agricultural Price Policy in the Context of Economic Development*

John W. Mellor

AGRICULTURAL price policy is a means for influencing the development and allocation of resources to society's objectives of growth and equitable distribution of income. Formulation of agricultural price policy is complicated by the multiplicity of often conflicting functions that price performs, including: (1) allocation of resources between agricultural and nonagricultural sectors; (2) allocation of resources within agriculture; (3) generation of additional resources for growth, particularly capital; and (4) distribution of income amongst regions, sectors, and income groups [8, 9, 10].

Agricultural price policy is of particular importance with respect to income distribution because agriculture produces the consumer goods that comprise the bulk of expenditure by low income people [1]. Even though agriculture is primarily a consumer goods producing industry, agricultural prices affect capital formation by their influence on distribution of income, industrial profits, and government net revenues [1, 6]. With respect to efficient allocation of resources, it must be remembered that the personnel and structure for administering price policy are also scarce resources that must be allocated efficiently. This places an important restraint on choice of optimal price policy. Finally, the actual price policy chosen will reflect the state of knowledge concerning the various variables. Uncertainty regarding the effects and objectives of price policy will normally necessitate adoption of policy different from those which would be preferable under conditions of certainty.

Agricultural price policy delineated in this paper assumes three prime characteristics of a country's economy: (1) that it is a low income country, with a small capital stock, a small capacity to save, a small supply of administrative talent, limited administrative structures, and a small command of financial resources by government; (2) that the requisites have been met for moderately rapid technological change in agriculture with constantly shifting production functions and declining unit costs of production; and (3) that economic growth is proceeding, with rising real per

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capita incomes and shifts in the demand structure for agricultural commodities towards higher income elasticity of demand commodities.

Basis for a Price Policy

The price policy discussed in this paper is applied to the basic food grains—normally a small number of closely related commodities, relatively nonperishable and, for most countries, consumed largely in the domestic market. For these commodities, a set of support prices would be set annually, with emphasis on support of that year's harvest season prices. The support level would be determined by an appraisal of the current supply and demand situation—the support level normally varying inversely with the size of the crop. The level set would be modestly below the calculated suppy-demand balance price. The primary purpose of this policy is protection of farmers against market imperfections and consequent sharp decline in price below the normal supply-demand balance price. Announcement of the support level would be made somewhat before harvest time, but sufficiently late to enable a reasonably accurate estimate of the domestic supply for that year. Presumably, trade policy would give appropriate consideration to international price relationships. The Government would accept deliveries at the support price, such supplies often being sold at a seasonally adjusted price the same year, and occasionally carried over to later years.

This policy has four major assumptions. First, rapid agricultural development is based on unit cost-reducing technological change, which is more a function of public policy towards research, education, and such matters than of price policy. Inappropriate price policy may slow technological change, but the prime function of price policy is to meet problems resulting from technological change rather than to create technological change.[1] Second, compared to high income countries, the demand for agricultural commodities is less inelastic with respect to price, and the effect on farm incomes of given market price declines also is much less. Third, in the dynamic context of technological change and economic growth, the basic price problem for agriculture is one of year-to-year instability, a problem which is particularly great in low income countries where the operation of markets may be particularly imperfect.

The concern for year-to-year price instability in a context of development assumes significant market imperfections. The method suggested for setting the support level achieves little in a situation of perfectly functioning markets. However, despite competitive conditions facilitated by easy entry, a large number of participants and a high degree of market integration, there are substantial, difficult to remove market imperfections in low income countries, tracing from costly and uncertain transport facilities and lack of knowledge of crop size and storage stocks [7, 12]. There is a tendency for such markets to operate naively and for movement in one direction to accumulate. Particularly where technological change and economic growth are both new phenomena, one can expect sharp changes in supplies of particular commodities as new technologies affect first one and then another commodity and as demand shifts accompany rising incomes. Such shifts in supply and demand can result in substantial changes in prices which may be accentuated by market imperfections.

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[1] Schultz has argued that agricultural production is impeded by "widespread underpricing of farm products and overpricing of agricultural inputs in poor countries" [15, p. 51]. Where such a negative policy has been followed, redress may be in order. However in situations in which such policies are often said to prevail, they apparently have not [11, 12]. In Taiwan they have prevailed, and agricultural development has proceeded rapidly anyhow [6].

Commodities to be Supported

Even supporting the prices of basic food grains runs the risk of exceeding the administrative, financial, and physical storage facilities available to government. The problem would be accentuated if prices of perishable commodities were supported as well. In addition, the complexity of setting suitable relationships among prices of various commodities increases substantially as the number of commodities increases. This will further strain the government's supply of analysts and administrators.

Basic food grains are the agricultural commodities for which the income elasticity of demand is the smallest. In the context of rapid technological change and income growth, resources should gradually be shifted away from these commodities toward the more income elastic agricultural commodities. There is a danger that limiting a price support program to food grains will channel resources towards rather than away from them.

It is logical to think that if the economy should be restructuring away from the basic food grains and towards the more income elastic types of agricultural commodities that a price support program might concentrate on the latter commodities. Unfortunately, the more income elastic commodities tend to be those that are relatively perishable and hence pose immense problems for the operation of a support program. Presumably, the most effective means by which government policy can improve prices for these commodities is through improved marketing facilities [4, 14].

Method for Determining the Support Level

It is proposed that the level of support be determined by estimate of the equilibrium price under the expected supply and demand conditions of the approaching year. Demand estimates may be based upon projections of population and per capita income, estimates of income elasticity of demand, and a measure of inflationary factors such as the money supply (see, e. g., [11]). Supply may be estimated either by sample observation or through projections taking into account changes in technology, inputs, and weather. If government capacity to support prices is weak and weather fluctuations large, it will be important to make the estimate close to harvest time. If weather fluctuations are unimportant or capacity to support great, little will be lost by setting prices even in advance of planting.

Cost of production should not be an explicit basis for determining the support level, partly because the context assumed is one of improving technology and hence declining unit costs[2] The basic incentive for expanding production is provided by declining unit costs, not rising prices. For similar reasons input subsidies are not recommended.[3]

The objective of the policy stated is not a constant level of agricultural prices. When favorable weather has provided a large crop, prices would be lower than when unfavorable weather has provided a small crop. In low income countries, the scope to expand consumption, even of basic food grains, through lower prices is greater than in high income countries. Further, real incomes of farmers tend to be higher with a large supply than with a small supply [10]. That is, of course, the opposite of the relationship expected in high income countries. The reasons for this reverse relationship are (1) demand is much less inelastic with respect to price in low income countries, and (2) a substantial proportion of basic food commodities are retained for home consumption and are not affected by a price decline incident to greater production. Of course, if demand is inelastic, those producers who sell practically all of what they produce may experience income changes inverse to level of production.

The Level of Support

If the objective of price supports is to protect farmers from market imperfections that drive prices below the supply-demand balance price, then the support price should be moderately below that price in order to allow the market to operate within reasonable bounds and to increase the probability that the policy can be administered.[4] There are two basic considerations in deciding how much below the supply-demand balance price supports should be set. First is the financial and administrative capacity to make support purchases; second, the degree of precision with which the appropriate price can be estimated. The lesser the capacity to make support purchases and the lesser the capacity to estimate the normal supply-demand equilibrium price, the greater the discount to be set for the support price; the greater the discount for the support price, the less helpful it will be to farmers. On the other hand, if the support is set so high that it cannot be maintained, confidence in the government's ability to support prices will be destroyed and susceptibility to sharp price decline increased.

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[2] For a contrary view and an excellent, extended discussion of agricutural price policy see [5].

[3] For a fuller explanation of the logic of this, see [8]; for illustration of the effect of technological change on returns to inputs, see [2, 6, 13].

[4] There is a naive assumption here that economists set agricultural support prices. In practice, political processes may dominate. This argues for caution in initiating price support programs and for thoroughly considering other devices to achieve the same ends. Certainly, programs of improved transport and market reporting should be studied as supplements and alternatives to price policy for dealing with market imperfections.

Timing Announcement of the Support Level

Announcement of the support level just prior to harvest season has the advantage of allowing more accurate appraisal of the supply situation, particularly with respect to weather. For most farmers in low income countries, a constant price irrespective of weather effects on crop size will *increase* fluctuations in real incomes as compared with basic supply-demand equilibrium prices. Thus, a policy of setting prices prior to planting would normally provide less farmer real income stability than setting them just prior to harvest. The converse is the case for consumer real incomes.

Announcing the support level prior to planting is necessary if the objective is to cause an immediate reallocation of resources towards specified crops. This is unlikely to be the objective with respect to the basic food grains in a context of economic development and technological change in agriculture.

Supports announced prior to planting, followed by unexpectedly large acreage planted or unusually good weather, may place burdens on the government which it is not able to sustain. With a resultant sharp price decline, farmers would be even less willing to plan on the basis of government supports in the future. Recognition of this problem may require that supports established prior to planting be set at a level lower than would be justified by later information. This could form part of a useful two-stage setting of supports—a conservatively low level prior to planting and a potentially higher level prior to harvest. It is, however, doubtful if the preplanting price would have sufficient credibility to be useful. It is also doubtful if political processes would allow this degree of fine tuning.

An Alternative Context for Price Policy

The policy context in low income countries has often been quite different from that stated above. In this analysis, we have assumed general economic growth with rising per capita income and technological change in agriculture causing lower unit costs of production. While that has been the situation in Japan and Taiwan during their periods of rapid economic growth and it is a situation commencing in most Asian countries at the present time, it has not been the dominant situation in most Asian countries over the last decade.

A common context has been one of growing population, modest industrial growth, slowly rising per capita incomes, and a technologically stagnant agriculture reflecting the classical case of diminishing returns to increased inputs [8, 9]. Agricultural prices are certain to rise under these conditions unless the demand for agricultural commodities is artifically contained or unless imports of agricultural commodities are increased.

If demand is artifically contained through price controls and rationing, purchasing power will be shifted to commodities that use scarce foreign exchange or that shift domestic resources towards consumer goods production—in each case reducing growth in the capital stock [8, 9]. If imports of food are financed from foreign exchange there will likewise be reduced growth through declining availability of imported capital goods.

If agricultural prices are not contained by restraining demand or increasing imports, resources will be transferred from the nonagricultural towards the agricultural sector of the economy. Under conditions of technological stagnation in agriculture, those resources will be subject to diminishing returns, causing rising unit costs of production in the agricultural sector. Concurrently, rising money wages and agriculturally based raw material costs will retard growth in the industrial sector [1, 6, 9].

The dilemma is clear and not likely to be met by price policy alone. What is needed is a public policy that will bring about rapid technological change in the agricultural sector—the context set at the beginning of this paper.

Consumer Protection

The effect of decline in production on farm incomes is partially muted by higher market prices, even for low income farmers who retain a substantial proportion of what they sell. The full brunt of higher prices falls on low income urban consumers, with essentially no forces to offset the effect in the short run. Consumer welfare and political considerations may require a storage and price stabilization program that would not be justified from a production point of view.

In the longer run, the consumer welfare problem becomes a problem of industrial capital formation. Assuming initial equilibrium with respect to the urban labor supply, a sharp rise in the cost of living of the low income urban labor force will force higher money wages, a squeeze on business profits, and a reduction in the rate of growth of the industrial capital stock [8, 9]. Thus, on the basis of both welfare and economic growth, one can argue for programs to stabilize supplies and prices of basic food commodities to low income urban consumers.

Government controlled buffer stocks can meet the need of urban price stabilization. Alternatively, at lower economic cost and higher political cost, rationing can be introduced during periods of scarcity, with supplies purchased on the market and rationed at subsidized prices to low income consumers. Consumption of low income consumers who have more elastic than average demand would be maintained at a higher level than would otherwise be the case. In consequence, the market price would be forced very high to reduce consumption on the part of high income consumers with highly inelastic demand. Under these circumstances, governments would normally choose a system of deliveries at controlled prices to reduce the price of supplies to be rationed to low income consumers. Alternatively, total production could be sequestered by government and rationed to all consumers. This would probably require a larger bureaucracy than a program that relied on high free market prices to ration to high income consumers.

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Discussion: Agricultural Price Policy in the Context of Economic Development

F. A. WILLIAMS

Admittedly, when one discusses a paper and begins to make reflections on it, one automatically tends to be in a quandary as to whether to concern himself with the real nature of the written product, provide a capsule summary, refer to some incidental description couched in its background, or to drift, so to speak, into a running description about the limits and boundaries of the work. To me, at least, it is axiomatic that I hardly know where to start; but I shall begin with a capsule summary and then engage in digressive and polemic expressions.

Professor Mellor's paper may be divided into four distinct parts: (1) an introductory statement, which embraces a definition of agricultural policy along with a delineation of the prime characteristics of low income economies; (2) the economics of price policy, including choices and the mechanistic rubrics of price supports, (3) alternative policy, and (4) consumer protection.

The paper has been done extraordinarily well in the context of his thesis. Many of the ideas, which at first appear to have theoretical and applied gaps, were somewhat explicitly liquidated in a second clause, paragraph, or sentence. Yet, I would say that any paper which deals with price policy for economic development in the less developed countries of the world, particularly in Asia and Africa, is bound to encounter for its author a problematic or indeterminate situation, for the field itself is underdeveloped. Mellor's paper did not say it implicitly, but *price policy itself must not only express an expansion in national income, but it must reflect an increase in the volume of purchases made by agricultural producers themselves.*

The heart of the paper, for the most part, rests in part two—the economics of price support policy in low income countries; however, attention will be given by this discussant in varying degrees to each part.

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The Paper's Introduction

Undoubtedly, Professor Mellor has well stated his belief relative to what agricultural price policy and its associated concomitants encompass. However, I am somewhat dubious as to whether he has not established or deduced an abstraction that does not entirely represent the various kinds of variables that agricultural economies have in his generalized low income nations.

In the first place, a disproportionately large number of these nations have within their boundaries at least three well-established agricultural systems: (1) a market or sales share of the economy, extremely specialized; (2) a totally subsistence section of the economy; and (3) a mixed agricultural system (specialized and subsistence). It may be that only a market economy lends itself to economic analysis, but any concept or theory on price support in the less developed areas must, of necessity, consider all forces within a given postulation, because each agricultural system has its own variables, including the impact of economic, demographic, cultural, political, and technological characteristics. Price policy that does not have accompanying measures designed to influence the number of entrants into agriculture may be self-defeating.

Furthermore, the paper seems to assume that a set of conditions exists in less developed nations, as in the more developed areas, where income will expand and purchases by farmers will also increase. Hence, in part one, the paper tends to suffer from the lack of empirically tested evidence to support the ideas set forth. Actually, this means that the paper's approach is largely deductive, with dynamic conditions as opposed to comparative statics; and, therefore, if an effective price policy is to be established from this discourse, it is not apparent, as it does not coincide with the experience of the discussant in a number of less developed nations. These nations will not have the sophisticated crop reporting mechanism for the implementation of the proffered price policy.

Economics and Mechanics of Price Support

Undoubtedly, this portion of the paper represents the heart of Professor Mellor's hypothesis on the theory of price support for less developed nations. It is in this part of his paper that our generalized tendencies seem to come to the fore with some sharp differences in point of view.

The paper limits agriculture price policy to food grains, which is a rather narrow concept, since there are a number of less developed countries with fiber and oil crops and animal products on a *sales economy* basis for both domestic and foreign markets, accompanied, therefore, with a less competitive market which would generate a higher income level in that it would provide for greater income elasticity.

Also, inextricably bound to this paper's stated policy is the observed fact that it does not leave room for the mobility of labor to sources of higher supply prices. Furthermore, this aspect of Mellor's paper does not seem to make it possible for the development of agribusiness types of industries as a corollary to the production of food grains. This would seem to be an appropriate development of markets based upon more elastic products. Also, early in the paper, the term *imperfect* needs more clarification, since a price support policy adds to the imperfections of a market economy in the classical context.

Moreover, it would appear that the paper has ignored entirely the American experience in supporting the production of basic crops. Perhaps this was overlooked because it is incorrectly assumed that a surplus of agricultural products seldom arises in less developed nations; but that is not the case with fiber crops in some of these areas of the world.

Incidentally, an inconsistency exists in a price support policy for the less elastic commodities, for this method will have price supports keeping resources allocated in these commodities rather than causing shifts to occur.

Another somewhat apparent weakness is that of supporting a maximum supply of food grains as opposed to a sliding scale of support with an optimum supply in order to free other resources for a hetero-development of the economy, making it possible for changes to become operative from year to year.

Furthermore, the paper indicates that the cost of production would not be a factor in the price support level based upon what occurs in the more developed countries; but, strangely enough, the cost of production would rise in the less developed nations due to the level of increase needed in capital inputs, especially in the short run, bringing higher costs and necessitating the consideration of new production costs as part and parcel of a support price. In other words, the state of the arts would largely determine the incentive for production. It is axiomatic that a price policy, as proposed for a less developed nation, may cause a slight rise in aggregate income while per capita income declines as more of the population will be forced to remain either in agriculture or enter into agriculture, thereby bringing into focus disguised unemployment or underemployment, which would not fulfill the function of the proper allocation of resources between agriculture and non-agriculture sectors of the economy. Consequently, the policy tends to over-allocate resources for agriculture in that it does no postulate a rise in the prosperity of urban areas.

The question to be answered is why induce a conceptualization that is purely oriented agriculturally, rather than for the economy as a whole. If the less developed countries are to progress with greater rapidity, economic models must be created which will make for total development rather than for a single sector that fails to develop a concept for a balanced economy. We must not accept the faulty assumption that agricultural output in food grains should take priority because there is apparent high demand for additional food and, therefore, imply that the greatest productivity of existing capital lies in agriculture. This approach will only lead to a higher rate of unemployment where there is already a scarcity of industrial enterpreneurship; but the idea is further complicated by the high ratio of dependents to producers found in African and Asiatic countries, thereby invariably minimizing any gains in per capita income.

Professor Mellor indicates the significance of timing in the price support level for these nations, I suppose, in order to minimize probable losses to governmental marketing boards. Prices that are not announced prior to production processes would not serve as an incentive for resource allocation in agriculture by holders of capital who are willing to make investments in agricultural productivity.

Alternative Context Patterns

In this section of the paper, Professor Mellor points out that agricultural prices will rise unless demand for agricultural commodities is artificially contained. Perhaps this is correct, but it is also a truth that purchasing power will rise under non-restraining policy where output is relatively stable and the anticipated shift to other commodities will not occur easily.

The real alternative does not rest in price controls and rationing for agriculture in the less developed countries, but the point must be reached where surpluses can arise, thereby creating a basis for investment so that employment opportunities may expand and keep pace with an excess population problem.

Professor Mellor leaves much to be said as to whether his price support contexts and alternatives follow logically from his basic assumptions relative to low income nations.

Also, in this portion of the paper, an implied assumption is present which indicates that agricultural production in the less developed countries is conducted under conditions of private property in land. An alternative in the Sudan is the Gezira Scheme, where the government either owns or rents the land and the net revenue is shared with tenants and–or owner-operators. Under this concept, prices for agricultural commodities are under the economic forces of competitive world prices.

It would appear that an admixture of prudent price policy on basic commodities, governmental monopolies, import duties, induced technological changes, and industrial expansion would enhance the trend for greater rapidity in economic growth. As pointed out by Professor Mellor, "these nations have a growing population, slowly rising per capita incomes, and a technological stagnant agriculture." Consequently, the dilemma cannot be resolved by a price policy rooted only in the output of food grains.

Consumer Protection

In the fourth and last part of the paper, I find myself in more agreement with Professor Mellor relative to the techniques which he would employ for protecting consumer welfare than in the previous three sections. Perhaps this is more important in a less developed country where there is a scarcity of nearly all resources than in a developed country where resources are generally in abundance and with consumer sovereignty running the gamut of elasticity of demand.

Even here, there is some doubt as to whether consumer welfare could be couched in economic class preferences because even in the urban areas of low income societies, incomes tend to equate with price increases for those with less elastic demand.

A Brief Concluding Statement

In conclusion, I have enjoyed both reading and discussing the paper presented by Professor Mellor. However, I must admit that a better title for the paper would have been something like, "Difficulties in Establishing Agricultural Price Supports in Less Developed Economies."

Discussion: Inducing Economic Development in Less Developed Countries

RICHARD PHILLIPS

It will be interesting to see what use, if any, future writers on economic development make of the contributions of this session. At least in part, the papers have emphasized policies and programs that the authors believe to be ineffective for inducing economic development. The Mellor paper recommends a very limited price support program to minimize interference with technological change in agriculture, improvement in marketing facilities, and other types of development. The Evans paper seriously questions the value to the developing countries of most foreign aid programs, particularly for achieving the stated goals of such programs. Both authors recommend reliance on programs to speed the adoption of agricultural technology as the main thrust for agricultural development. They see agricultural price policy and foreign aid as relatively ineffective tools that are often misused in attempting to speed economic development in the developing countries.

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Agricultural Price Policy

The kind of agricultural price policy proposed by the Mellor paper would give food grain producers a price floor, primarily for protection against short-run price declines. If these price floors are set at levels somewhat below the equilibrium price just prior to harvest, as suggested, the price policy should have relatively little effect on the rate of economic development, either positive or negative. Certainly this kind of policy would cause less interference with the rate of development than many of those that have been tried in developing countries around the world. As the author points out, the policy would offer low income urban consumers no protection against sharply rising food grain prices.

If one accepts the basic assumptions of cost reducing technological change, rising real per capita incomes, and major imperfections in the markets for agricultural products, the policy recommended by Mellor should achieve the intended goals at a minimum cost to society. Presumably, other kinds of programs and policies would be used to overcome the major imperfections in the markets for farm credit, fertilizers, and other inputs, as well as in land tenure systems. In many developing countries, imperfections in these markets must be overcome before the assumption of cost reducing technological change can be realized.

The reader is still left with the question of whether some type of agricultural price policy could be devised for developing countries that would contribute directly to the rate of economic development. With the recent work toward applying input-output and other structural models to problems of development, it seems possible that the basic requirements for such a policy can be specified. The direct and indirect effects of agricultural policy through all sectors of the economy are complex, and the combined impact would vary from country to country. Yet well conceived structural models should be capable of predicting and measuring these effects.

Foreign Aid

There is much with which one can argue in the Evans paper, but many of the points are well taken. The conflict of such goals as economic growth and income distribution is a perpetual problem; and for many countries, the latter is overriding. The objectives of the "donor" country often do overshadow the objectives of the "recipient" country in foreign aid programs. One must agree that, at least within the present concepts of national and private property, there is no hope of closing the gap between affluent and poor countries.

Accepting the statement that *"development occurs when resources are allocated to produce the goods and services essential to human well-being in increasing quantities, and when the people in the greatest need are* *able to obtain and consume them,"* one can argue for an increasing amount of foreign technical and capital aid, even under the terms of the donor country. In addition to the value of the infrastructure projects recognized in the Evans paper, foreign capital and know-how are essential ingredients for effective resource allocation in agriculture and other private sectors in many developing countries. Perhaps the problems have not been with the volume of foreign aid, nor even with the conditions of the donor country, but with the practice of routing aid through "government-to-government" channels which could have been more effective through other channels. Government-to-government channels have provided reasonably effective foreign aid for roads, schools, hospitals, and other infrastructure developments, even with the changing political scene in many developing countries; but government-to-government foreign aid often has been far less effective in agriculture and industry.

There are other channels for routing foreign aid which are meeting some success in developing countries. The cooperative-to-cooperative programs are assisting in providing off-farm opportunities, as well as helping to improve imperfections in farm supply and product markets. The concept of domestic and foreign investors used in Iran is effective in mobliz-ing foreign private capital and know-how for industrial development, while maintaining control in Iranian hands. The same concept is now being applied to commercial agriculture in that country. In some cases, the direct entry by foreign corporations has materially contributed to economic development as defined in the Evans paper.

This writer is in full agreement that land and capital income, as well as labor income, are needed if low income subsistence farmers in developing countries are to reach satisfactory levels of living. However, this does not mean ill-conceived land reform programs to split up the larger farms and divide the spoils among the landless class. Many such programs have retarded the rate of technological change and economic development in agriculture. Egypt is a case in point. Large and small farms will coexist successfully in developing countries, just as they do in the affluent societies.

ANALYTICAL TECHNIQUES APPLICABLE TO DOMESTIC DEVELOPMENT

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Tools of the Trade in Policy Decision—PPBS, a Case in Point*

WILLIAM B. LORD AND STEPHEN C. SMITH

FOUR years have passed since Lyndon B. Johnson announced the initiation of PPBS (Planning-Programming-Budgeting System) to guide and improve the decision-making process of the Federal executive branch agencies. In this paper, we examine the nature of PPBS, and the nature of the decision-making process that has evolved in one area—water resources. We shall examine in turn the kind of decision structure that PPBS seems designed to serve and the kind of decision structure that now exists in Federal water resource activities. We note a basic inconsistency between PPBS and the existing decentralized and pluralist decision process. Finally, we offer some observations as to how PPBS may be modified to both serve and improve that decision process.

I.

> As presently conceived, program budgeting contains an extreme centralizing bias. Power is to be centralized in the Presidency (through the Budget Bureau) at the national level, in super-departments rather than bureaus within the executive branch, and in the Federal government as a whole instead of State or local governments [3, p. 305].

Wildavsky's assertion accurately describes the implications of the information display scheme, the preoccupation with economic efficiency thus far embodied in benefit-cost analysis, and the spirit and application of PPBS in the MacNamara revolution.

Major budgetary decisions are to be made on a departmental level rather than at bureau or lower levels. The information displays in the Program and Financial Plan and the Program Memoranda are prepared to enable department level managers to make such decisions. Lower level

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managers may find that new alternatives may emerge from the information they are required to send forward, but the aggregation of such information at higher levels may lead to program choices quite different from those that appear best at the lower levels.

Although they are not a part of the information format itself, techniques such as benefit-cost analysis are an important ingredient of PPBS. This paper is not the place for an extended discussion of benefit-cost analysis. It is relevant here, however, to point out that benefit-cost analysis, which has been called applied welfare economics, has been centrally concerned with the aggregate level of real national income (as the empirical surrogate for social welfare). Few economists would deny the importance of this concept as a desideratum in public decision making, just as few would deny that it is the sole desideratum. But benefit-cost analysis as it has developed has been preoccupied with national economic efficiency. Words of warning about over-concentration on this objective have not been taken too seriously [2, pp. 266–268]. By ignoring the politically important distribution aspects, benefit-cost analysis has not served the information needs of the many interest groups and lower level governmental units that participate in water resource decision making. The national taxpayer's interest in efficiency has been served but not the needs of each of us in our other roles in a pluralist democracy. The customary benefit-cost analysis has a particular relevance, albeit a partial one, to decisions of the President and the Bureau of the Budget but less relevance to bureaus, interest groups, industries, and state, local and special governmental units.

The questioning spirit of PPBS also favors centralization of decision making. Under Secretary MacNamara every recommendation was to be accompanied by supporting analysis, including a presentation of the major alternatives considered and the reasoning behind their rejection. A formal dialogue between decision-making levels was encouraged, but the decisions themselves were reserved to the Secretary. What other advantages or disadvantages this method of operation may possess, its centralizing tendencies can be utilized by an aggressive administrator.

II.

The field of water resources offers a good behavioral area to examine the effects of economic and technical concepts upon our institutional structure for making decisions. In this vein, the centralizing capability of PPBS has been noted, but two other technical concepts preceded PPBS and moved with force in the same direction. Benefit-cost analysis has been mentioned. Its emphasis on national income objectives grew compatibly with the development of macro economics as it became incorporated into the central body of economic thought. Thus, the economics profession has developed a set of analytical concepts that views the decision system from "the top down" and reinforces value judgments integrated by this system. In a similar fashion, basin-system analysis, which has been growing over a like period, reinforced these centralizing tendencies, since one of its objectives has been to internalize former externalities. These are not new concepts. They have been evolving for a long time, with their force becoming increasingly potent since their clear legislative articulation in the 1930's.

Our comments should not be misinterpreted to imply that these conceptual structures had no pre-existing behaviorial basis—they did, but time will not permit their detailing. A hint of their character can be noted, however, in the tracing of some elements of the decision pattern.

Water resources decisions still have deep roots that relate them to our system of property rights. This link, and the attendant role played by the property rights system in our economy, frequently create a discontinuity in defining decision problems and their solutions. Approaching the decision structure from this perspective, the view is from "the bottom up," and in contrast to the previously noted "top down" vista.

The "bottom up" approach is a different system, held together by a different set of logical threads tied to different objectives. The articulation of this system and its examination on its own terms have been infrequent. Most studies have applied the "top down" logic to the "bottom up" facts and have produced large "disparities" between objectives and accomplishment.

Our property system has led to a pluralistic system of decision making involving many individuals, each with his own objectives, participating in a highly decentralized decision process. Economic returns to the individual come from at least two sources: (1) the return from privately producing a product or a desired service for market, and (2) current and prospective rents, deriving from power over property. By the turn of the century, however, economic, physical, and political realities were bringing home the existence of externalities to the individual and the necessity of group action to partially internalize costs and returns to water development. To achieve the necessary scale, a variety of organizational structures and combinations were utilized. These ranged from private associations and companies, local districts, and units of government, to such Federal organizations as the Corps of Engineers, the Bureau of Reclamation, and the Soil Conservation Service. Local interest groups bargained *through* these Federal agencies to achieve their objectives. This Federal-local relationship, in turn, created the political backing necessary for the establishment and maintenance of the Federal agency structure. The Federal decision structure was not an abstraction, but an organization to distribute funds in certain ways.

At the national level these "local" projects were sifted and judged with respect to (1) a given level of the Federal budget, (2) whether the budget should be larger or smaller, and (3) when each project should start. They came up through the system largely on the basis of their own "merits" and backing to accomplish a local purpose. Federal criteria were not maximizing or optimizing in character, but more in the nature of a minimum standard. In any given year, competition from other desired projects played a role. Also, the relationship to obtaining or withholding services in other fields of endeavor was taken into account in a very limited and implicit way.

This community approach to Federal investment fit the Congressional model. Pluralistic decision making, however, came under pressure with the recognition of new and larger externalities and as a result of a vast amount of construction. Benefit-cost analysis had expressed a Federal interest by setting a "minimum standard" for screening projects, but the agency-local interests were still paramount. Basin analysis and management was attempting a new integration of the externalities from individual projects, and PPBS required the formulation of national objectives *within* the bureaucracy. All of these forces have been and are revealing the disparateness of objectives and the fact that there are serious limitations under present day conditions to the project by project approach. Likewise, the realization is growing that the identification of objectives by a single bureaucratic process or pronouncing them "ex cathedra" by a professional elite is neither adequate nor appropriate.

III.

The major direct effects of most Federal water resources program decisions are "local," and the public they serve is limited. To be sure, all taxpayers share minutely in paying construction costs under present cost-sharing rules, but the other impacts of each project (or new program) decision on the general taxpayer are likely to be slight by comparison with its impact on those who are its direct beneficiaries or who bear its external costs. Even the large basin projects are local in impact by comparison with other Federal programs in such fields as defense, foreign relations, taxation, health, urban affairs, civil rights, aviation, and education. Indeed, it is their pronounced local or regional nature that has made water resource projects the objects of such intense Congressional interest.

The national interest in Federal water resource programs has several aspects. The first of these stems from the various national goals or objectives, which the Federal government is attempting to achieve but which may or may not be considered at the regional or local level. Historically, such objectives as developing the West, conserving the soil, and providing a free system of navigable waterways have often been cited in support of water resource proposals. Critics have charged, rightly, that objectives of this kind are often employed to rationalize the self-interest of user groups. One of the salutory effects that may be expected to follow the introduction of PPBS is the devotion of increased critical attention to national goals and objectives. Both policy makers and analysts will be defining objectives in operational terms, questioning their relevance, examining the actual consequences of attaining them, and continually reformulating them in the light of experience. Objectives such as reducing personal income disparities and minimizing environmental deterioration are already achieving a status comparable to the more traditional objectives mentioned above.

Economic analysis can be helpful in the examination and redefinition of Federal program objectives. The externality concept is central to this effort. A national interest justifying Federal participation in decision-making and, possibly, cost-bearing may be defined whenever a regional water resource program or project seems likely to confer major benefits or costs upon parties outside the planning region. In such cases Federal participation can help to internalize the externalities and produce solutions that are more desirable socially.

A second aspect of the national interest in Federal water resource programs, national economic efficiency, arises primarily because Federal funds are used. The traditional role of the benefit-cost ratio, however imperfectly it may have been computed in some cases, has been to prevent the flagrantly inefficient use of Federal funds. The proper role of the national economic efficiency criterion in water resource program evaluation has been perceptively discussed recently by Castle and Youmans [1, pp. 1660–1665].

A third aspect of the national interest, and one which also stems from the use of Federal funds, is distributive in nature. Our national political system is vitally concerned with the distribution of Federal spending among the various states and congressional districts. Local projects, such as those in the water resources field, constitute an important part of this congressional rewards and penalties system. PPBS can contribute to the evaluation and improvement of this system by revealing the nature and extent of the resultant distributive changes and thus provide a measure of some of the costs of the system.

This suggests that the complex and decentralized decision-making system that has evolved through water resources development may more effectively recognize the extent and limitations of interests than does the decision-making system implied by PPBS, as it has developed in the area of national defense. If we do not wish to make water resources decisions in a centralized and hierarchical manner, PPBS had best be modified to effectively serve a decentralized decision-making process, for the weight of information and analysis is great and its effects on decisions will not be denied, however imposing the inertia of the existing system may now seem to be.

We conclude, then, that at the Federal level PPBS should be directed toward such Federal objectives as alleviating poverty and protecting the environment. However, a basic Federal decision appears to be the distributive one, and this is consistent with current political decision making in this area. Economic analysis in PPBS should show clearly who gets what and at whose expense for each proposed project. The Federal PPBS information display should focus on the allocation of Federal funds among the various regions, states and river basins. The rate at which Federal funds would be provided to each planning unit would then be determined at the national level. Water resource programs could be compared with and aggregated with other Federal programs to make such distributive effects more visible and subject to greater overt political attention.

While the rate of Federal spending in each region for water resource projects (and possibly other functions as well) would be determined at the national level by the President and the Congress, how that money was spent would be left for local determination, subject to nationally established constraints, such as environmental degradation, national economic efficiency, and, possibly, personnal income distribution. If given a limited amount of Federal funds, local interests might be more discriminating in their choices as to how to spend. Wider competition and bargaining at the local level could eliminate many wasteful and ineffective projects that now survive for want of local opposition.

The kind of PPBS we have proposed relies heavily on river basin planning for both information and decisions. Programs would be regional rather than national ones. They would be developed at the regional level (as has been happening in California and Texas). Federal participation in program planning would occur only for two reasons: (1) because Federal or multi-regional interests were affected, or (2) because Federal funds were employed. In the first instance, that of externalities, joint decision making and bargaining between regional and Federal representatives is required. The PPBS information display should show the nature of the externalities in order to facilitate this process. In the second instance, that of Federal cost-sharing, the essentially Federal decision concerns the rate of spending in each region. Both the President and the Congress could well concentrate upon this decision if the program content decisions, which are not primarily matters of Federal concern, were not forced upon them. The information provided by PPBS can serve to pose the proper questions and illuminate the choices that can best be made at each level of decision making.

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Estimating the Effects of Resource Development Programs on Regional Employment

B. R. EDDLEMAN

MANY variables interact to determine the pattern of employment changes occurring within an area. Changes in investment levels that shift the supplies of critical resources often occur concurrently with changes in the demands for products, supplies of other resources, firm production possibilities, and the number of firms. Each of these separate types of changes can have a substantial effect upon labor employment. A continuing problem is how the relationships among these variables can be identified and taken into account in attempts to assess the separate employment effects of resource development programs. An important element is the consideration of how equilibration in product and factor markets is affected by programs designed to change the supplies of resources and, in turn, how changes in product and factor prices affect the level of output and resource employment within the recipient area. A general approach to this type of problem has been suggested by Tolley and Schrimper [3, p. 115], and Schrimper [1; 2, p. 141]. Their approach simultaneously considers aggregate and micro adjustments in product and factor markets.

In the first part of this paper, we will consider a theoretical framework for determining the separate effects of resource investment programs on changes in regional employment of labor. This model is a special case of the more general formulation by Tolley and Schrimper and is a variant of the regional adjustment model developed by Schrimper [1]. The second part of this paper will be directed to a discussion of possible alternative empirical investigations of the relationships suggested by the model.

Regional Employment Adjustment Model

There are three basic types of components in the regional model of adjustments. These are: (1) factor demands of firms in individual types of industries, (2) aggregate product demand and factor supply functions, and (3) the number of firms in the different industries. Exogenous changes in any of the components can have substantial effects on employment in a region because of the interaction among the various functions. This interaction operates primarily through changes in the prices of products and factors, which are determined at the aggregate level but have an important impact on output and input decisions made by individual firms. These latter decisions may result in additional changes at the aggregate level leading to

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still further price adjustments. According to the model, equilibrium exists when all product and factor prices are consistent with their total demands and supplies.

For most areas, several but not all product and factor prices might be realistically assumed to be fixed, since adjustments within the area would not be likely to have a perceptible influence on the total markets for these commodities. Feedback effects associated with adjustments would operate primarily within factor markets since nearly all product prices, with the exception of those products produced for local area markets, would be largely exogenous to an individual area. Therefore, in the model, the product demands and the supplies of all but the nth factor are assumed to be perfectly elastic for an area in which r different types of industries exist and produce m different kinds of products with n-m different kinds of factors. Firms within each of the r industry groups are assumed to have similar production possibilities and be operated by basically the same type of entrepreneur.

Under these assumptions, and denoting base quantities of the nth factor as $Q_n{}^0$, the proportional change in the aggregate demand for labor (i.e., employment) in an area can be expressed in the following form:

$$
\begin{aligned}
(1)\qquad \frac{dQ_L}{Q_L} = & -\frac{\bar{\alpha}_{Ln}Q_n{}^0}{Q_n{}^0(\eta_{nn}-\bar{\alpha}_{nn})}\sum_{f=1}^{t}\tau_{nf}\frac{dX_f}{X_f} \\
& + \sum_{j=1}^{m}\left[\bar{\epsilon}_{Lj}+\frac{\bar{\alpha}_{Ln}Q_n{}^0\bar{\epsilon}_{nj}}{Q_n{}^0(\eta_{nn}-\bar{\alpha}_{nn})}\right]\frac{dP_j}{P_j} \\
& + \sum_{i=m+1}^{n-1}\left[\bar{\alpha}_{Li}+\frac{\bar{\alpha}_{Ln}Q_n{}^0(\bar{\alpha}_{ni}-\eta_{ni})}{Q_n{}^0(\eta_{nn}-\bar{\alpha}_{nn})}\right]\frac{dP_i}{P_i} \\
& + \sum_{h=1}^{v}\left[\bar{\gamma}_{Lh}+\frac{\bar{\alpha}_{Ln}Q_n{}^0\bar{\gamma}_{nh}}{Q_n{}^0(\eta_{nn}-\bar{\alpha}_{nn})}\right]\frac{dZ_h}{Z_h} \\
& + \sum_{k=1}^{r}\left[\frac{q_{Lk}}{Q_L}+\frac{\bar{\alpha}_{Ln}q_{nk}}{Q_n{}^0(\eta_{nn}-\bar{\alpha}_{nn})}\right]dN_k
\end{aligned}
$$

where

Q_L = total quantity of labor demanded in the area

$Q_n{}^0$ = total quantity of the nth factor initially utilized

$\bar{\alpha}_{Ln}$ = weighted elasticity of demand for labor w.r.t. the nth factor price (weighted by the proportion of total demand for labor attributable to each industry)

$Q_n{}^0(\eta_{nn}-\bar{\alpha}_{nn})$ = difference in the quantity of the nth factor that would be demanded and supplied at a price 1 percent from its equilibrium value

η_{nn} = elasticity of supply for the nth factor w.r.t. its own price

$\bar{\alpha}_{nn}$ = weighted elasticity of demand for the nth factor w.r.t. its own price (weighted by the proportion of total demand for the nth factor attributable to each industry)

τ_{nf} = elasticity of supply for the nth factor w.r.t. the fth shifter of factor supplies (X_f)

$\bar{\epsilon}_{Lj}$ = weighted elasticity of demand for labor w.r.t. the jth product price (P_j)

$Q_n{}^0\bar{\epsilon}_{nj}$ = change in the demand for the nth factor resulting from a 1 percent change in the price of the jth product

$\bar{\epsilon}_{nj}$ = weighted elasticity of demand for the nth factor w.r.t. the jth product price

$\bar{\alpha}_{Li}$ = weighted elasticity of demand for labor w.r.t. the ith factor price (P_i)

$Q_n{}^0(\bar{\alpha}_{ni}-\eta_{ni})$ = difference in the quantity of the nth factor that would be demanded and supplied at initial equilibrium price after a change of 1 percent in the price of the ith factor

$\bar{\alpha}_{ni}$ = weighted elasticity of demand for the nth factor w.r.t. the ith factor price

η_{ni} = elasticity of supply of the nth factor w.r.t. the ith factor price

$\bar{\gamma}_{Lh}$ = weighted elasticity of demand for labor w.r.t. the hth shifter of firm production possibilities (Z_h)

$Q_n{}^0\bar{\gamma}_{nh}$ = change in the demand for the nth factor resulting from a 1 percent change in the hth shifter of firm production possibilities

$\bar{\gamma}_{nh}$ = weighted elasticity of demand for the nth factor w.r.t. the hth shifter of firm production possibilities

q_{Lk} = quantity of labor demanded by a firm in kth industry

q_{nk} = quantity of nth factor demanded by a firm in kth inudstry

dN_k = change in the number of firms in the kth industry

The above equation indicates how changes in the exogenous shifters of factor supplies, product demands, firm production possibilities, and the number of firms affect the demand for labor in an area. All of the coefficients for the first four types of shifters relate to the effects emanating from existing firms in the area, whereas the final term takes into account the effects of shifts in the number of firms. The impact of each of these shifters on changes in employment occurs either through a direct shift in the demand for labor or through changes in the prices of factors with other than perfectly elastic supplies that affect labor demands.

One term which is present in each of the coefficients of the exogenous shifters is $Q_n{}^0(\eta_{nn}-\bar{\alpha}_{nn})$, which gives a measure of the amount by which the quantity demanded of the nth factor would differ from the quantity supplied at a price 1 percent from its equilibrium value. Thus, the absolute value of this term represents the change in demand or supply for this factor that would be consistent with its price changing by 1 percent. The reciprocal,

$$\frac{-1}{Q_n^0\ (\eta_{nn}-\bar{\alpha}_{nn})},$$

can then be interpreted as the approximate percentage change in price for each unit change in demand or supply of this factor resulting from exogenous shifters in the model.

The first term in equation (1) indicates the effects of specified changes in the supply of the factor assumed to be other than perfectly elastic for the area. These types of changes would be expected to affect the price of the *n*th factor and thereby influence the demand for labor. For example, if the supply of this factor increased in an area as the result of a planned program of resource development, its market price would be expected to fall. Such a change could act as an incentive for existing firms to substitute the factor for labor to the extent possible within given production techniques. In this case of technical substitutes, the net effect would be a decrease in the demand for labor by existing firms in the area, *ceteris paribus.* A negative value for the $\bar{\alpha}_{Ln}$ terms would indicate technical complementarity between labor and the *n*th factor. Thus, the direction and magnitude of changes in the demand for labor due to a given change in the supply of the critical factor would vary among areas in proportion to the algebraic sign and the size of the $\bar{\alpha}_{Ln}$ terms. If any of these terms were zero, it would indicate that the change in the critical factor's supply had no effect on employment changes in the area's economy. This would mean that either the area's firms did not use this factor or their labor demand functions were perfectly inelastic. In general, a given change in the supply of the *n*th factor would result in larger changes in employment for those areas comprised of industries whose labor demands were more responsive to changes in the price of the *n*th factor or which used larger amounts of the *n*th factor. The effects of any change in the supply of the *n*th factor would also be greater for areas in which the demand and supply of the factor were more inelastic, which would be represented by a smaller absolute value of $Q_n^0(\eta_{nn}-\bar{\alpha}_{nn})$.

The effects associated with the remaining exogenous shifters are similar in that the coefficients are composed of a direct and indirect response in labor demands. The employment change associated with changes in product prices, indicating shifts in product demands assumed to be perfectly elastic, is represented by the second term in the equation. Changes in product prices would be expected to change net returns of existing firms and thereby serve as an immediate incentive for output to change and, thus, for direct shifts to occur in labor demands. This effect is taken into account through $\bar{\epsilon}_{Lj}$, which represents the elasticity of demand for labor with respect to the price of the *j*th product. As output from existing firms changed, the demand for the *n*th factor would also shift, resulting in a change in this factor's price. The price change for the nth factor would result in an indirect shift in labor demands through the $\bar{\alpha}_{Ln}$ term. In the case of substitutes, an increase in the price of a product would be expected to increase the demand for labor indirectly through an increase in the price of the nth factor. Thus, the direct and indirect effects of a product price change would operate in the same direction on labor demands. The indirect effect would tend to be larger for areas with larger values of $\bar{\alpha}_{Ln}$ and $Q_n{}^0\bar{\epsilon}_{nj}$ or smaller absolute value of $Q_n{}^0(\eta_{nn}-\bar{\alpha}_{nn})$. For those industries in an area that did not produce any of the product whose price increased, the employment effects would be only in terms of the resulting price change for the critical factor.

Changes in the prices of factors, representing shifts in the factor supplies assumed to be perfectly elastic, would affect employment in much the same manner as changes in product prices. Higher factor prices would decrease the net returns of existing firms in an area and thus serve as an immediate incentive for firms to substitute other factors for those experiencing increased prices. As firms respond to the new situation, the demand for labor as indicated by the direct component, $\bar{\alpha}_{Li}$, would increase. Similar adjustments would occur in the nth factor market, resulting in an increase in the nth factor price. The latter change, represented by the indirect component, would tend to complement the initial adjustments associated with the direct effect unless the supply response of the nth factor was of such magnitude as to offset the effects of the increased demand for this factor.

It is more difficult to indicate the direction of change in employment resulting from exogenous shifters affecting firm production possibilities than for the other types of shifters. Shifts in Z_h could result in increases or decreases in the demand for labor directly, as well as for the nth factor, depending upon how each of the components of the coefficient were affected. In the absence of any inherent labor-saving biases, if the price of the nth factor increased due to an output-increasing change in production possibilities, the direct and indirect effects would complement each other. The demand for labor would be expected to increase. For price decreases of the nth factor, however, the two components would operate in opposite directions. The actual direction in which employment would change depends upon whether $\bar{\gamma}_{Lh}$ is larger or smaller than $\bar{\alpha}_{Ln}Q_n{}^0\bar{\gamma}_{nh}/Q_n{}^0(\eta_{nn}-\bar{\alpha}_{nn})$.

Employment changes resulting from increases in the number of firms occur in a manner similar to the changes associated with product prices. This results from the positive relationship between the demand for labor and changes in the prices of critical factors. The entrance of new firms would directly increase the demand for labor and would indirectly increase labor demands by bidding up the prices of critical factors.

Empirical Investigations Suggested by the Model

The above discussion emphasized the interrelatedness of programs designed to shift the supplies of critical resources in an area and changes in other economic phenomena that affect the markets for these resources. This section includes a brief discussion of the general nature of two types of empirical studies under way to assess the revelance of the framework in explaining employment changes among and within areas in Florida.

Generally, the same types of independent variables are being developed for inclusion in each of the empirical investigations, whether it is a cross-sectional single equation or a time-series simultaneous equation system of analysis. These variables consist of changes in variables, observed either annually or between census dates, which are assumed to be analogous to the effect of differential changes in particular exogenous shifters. For example, percentage changes in farm commodity allotments, total current education expenses, total cumulative highway construction investments, ACP payments for farmland development, and total cumulative construction expenditures for water resource development are used to represent changes in important factor supplies in the areas. As an alternative to education expenditures, percentage changes in hired wage rates are used to indicate possible differences in the rates of change in the supply of labor. Weighted indexes of changes in product prices and output per man-hour are used to represent exogenous changes in product demands and firm production possibilities, respectively. The actual change in firm numbers is used to explain variation in employment due to decisions of firm operators to enter or exit from production within areas. Measures of changes between 1959 and 1964 in these variables for each major type of manufacturing industry and for agriculture are being developed for every county in Florida. Annual estimates since 1947 of these variables are being developed for a region composed of thirty-seven countries in the northern and western portion of the state.

In the first approach, a two-sector adaptation of the model composed of the agricultural and manufacturing sectors of each county is being used to estimate the relationships set forth in the theoretical discussion. The linear relationship between percentage changes in total employment and measures of the various exogenous shifters described above provides the basis for an investigation of the extensive variation in employment changes between 1959 and 1964 among counties in Florida. Two separate multiple regressions are being estimated with this data. One regression includes all of the independent variables associated with the specific shifters. Another regression is a special form of the first type and includes only the variables whose coefficients are significantly associated with the changes in employment based on the results of stepwise regression procedures. A comparison of the estimated coefficients of the exogenous shifters from these regressions would indicate the specific types of variables (i.e., shifters of factor supplies, product demands, firm production possibilities, or changes in firm numbers) that explain the largest proportion of total employment variation.

The above type of analysis provides some insight into the relative importance and effect of changes in each type of shifter on employment variations among areas. However, a single equation analysis cannot give an accurate picture of the interrelatedness of the employments among industries within an area, for it tends to aggregate out of existence the elements that produce change in an economic system. For this reason, a different approach based on the same general conceptual framework expressed in the regional model of adjustment is being used to examine employment variations among industries for the multicounty region.

With only minor modifications, the general relationships of equation (1) provide the conceptual framework for analyzing proportional changes in the demand for labor within a given industry. By replacing the weighted elasticity terms in the coefficients of the exogenous shifters with the specific elasticities for the given industry and eliminating the summation over all industries, the dependence of employment changes in an industry on the exogenous shifters of the model may be expressed. For example, in the first term of equation (1), $\bar{a}_{Ln}$ would be replaced by α_{Lnk}, the elasticity of demand for labor in the kth type of industry with respect to the nth factor price, and $\bar{a}_{nn}$ would be replaced by α_{nnk}, the elasticity of demand for the nth factor in the kth industry with respect to its own price. The resulting equation after making all of these substitutions in the coefficients of the shifters would reflect the dependence of proportional employment changes in the kth type of industry on given changes in the exogenous shifters in the model.

Using time series data for the dependent and independent variables, separate multiple regressions can be estimated for each major type of industry in the multi-county region. While the findings of such an investigation have considerable value for evaluating the effects of the various types of shifters on employment changes in the specific industries, structural equations would treat far more adequately the effects of the interrelatedness of the employments among industries.

Such a structural or simultaneous equations approach to the study of the region may not reveal all of the economic mysteries and the future of the region. However, these equations, when properly solved for their coefficients or parameters, do delineate the regional economic structure and provide information about it as can no other approach. This information is in the nature of statements about the quantitative properties of the various variables that were theoretically specified and joined together statistically to portray the economy of the region. Such knowledge about the quantitative properties may be tied in with other quantitative methods, such as input-output analysis, and with qualitative information to make possible the best judgments about the future of the region.

Concluding Remarks

The attempt in this paper to devise a framework for evaluating the separate employment effects of variables affecting the demands and supplies of factors in a region is motivated by an interest in finding a fairly comprehensive delineation of a regional economy and evaluating the effects of resource development programs on this economy. Such a delineation must be in the realm of the measurable, and the values measured must reflect both interdependency and independency of the economic variables used. Employment by industry has been suggested as the variable to be explained. The explanation of how employment is formed and how it varies leads to a useful structural description of a region. To be sure, the value of employment varies by regions and varies from industry to industry within regions. Consequently, its effect upon the region varies by industry. It is this variability that the structural system of equations picks up more efficiently than does any other method of analysis. A useful delineation of a region and the factors behind its behavior and development can be derived from a limited set of equations so long as the interdependencies are established and measured.

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Estimating Contributions of Natural Resource Investments to Objectives in Regional Economic Development*

W. B. BACK

MY principal purpose is to assess the status of methods for estimating contributions of Federal water resource development projects with respect to regional economic objectives. Emphasis is upon problems experienced both by the Federal agencies and by those with responsibilities for assisting in economic evaluation of the projects.

Two theses underlying this paper are: (1) Appropriate procedures in benefit-cost analysis, as applied to regions, require a foundation in relevant concepts and theories of regional economic development; and (2) efforts to develop methods for estimating the more dynamic effects of water projects should be preceded by the development of defensible measures for the less dynamic effects.

Objectives of Water Resource Investments Relating to Regions

A recently released report of a special task force of the Water Resources Council advocated measurement of effects of water projects in terms of four sets of "national" objectives—national income, regional development, environmental, and well-being [5, pp. 16–25]. Regional development objectives included increased regional income, increased regional employment, improved regional economic base, improved income distribution within the region, and improved quality of services within the region. The expressed regional development objectives are not mutually exclusive; if values are assigned to each objective, there is a possibility of multiple counting of benefits by the agencies. This danger of multiple counting is accentuated when several agencies claim benefits to projects within the same region and interregional or interindustry distributional effects are ignored. A view apparently taken in the task force report was that water projects could be designed to accommodate any of a large number of combinations of national and regional objectives [5, pp. 72–73]. I wish to challenge this view.

In our optimism about beneficial economic effects of water projects, we often neglect the limits imposed by their physical purposes—flood control,

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* Comments and suggestions from Robert Boxley, William Heneberry, Harold Marshall, Morris Weinberger and Gene Wunderlich were used in developing this paper.

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navigation facilities, irrigation, water supplies, power, etc.—and the highly functional nature of the planning necessary for their achievement. The limited scope and content of physical objectives—for example, usually what can be obtained by a system of reservoirs in a watershed or river basin—suggests that water projects may be inefficient or ineffective as public instruments for achieving many of our major economic objectives, including those for regions. I suggest also that the highly functional nature of these purposes severely limits management of the indirect effects by water project designers. The failure to fully and explicitly recognize such limitations of water projects could deter public consideration of more relevant programs and policies for attacking our major economic problems.

I propose that we restrict ourselves to three dimensions of regional development; namely, (1) increase in aggregate income within the geographical area designated as the region, (2) increase in income of those people within the region who fall in the lower income classes nationally, and (3) increase in efficiency in the use of the region's resources. Parallel views of regional development are discussed by Leven [2, pp. 1–12].

An increase in the aggregate income of a region is the objective sought by those identified by Leven as the self-interest group. Proponents of the second and third objectives mainly are interested in national rather than strictly regional (self-interest) economic objectives. However, these also are objectives in regional economic development because each relates to levels and distribution of income of people within a region.

The task force does not adequately distinguish or relate three types of income distribution: geographical, within-region personal, and national personal. Also, the sharing of benefits and costs of water projects permitted by law apparently was equated with a national objective in income distribution [5, p. 24]. In my view, national personal distribution of income is the central consideration in any national objective about income distribution. Other types or attributes of income distribution are relevant considerations only to the extent they affect the national personal distribution. One possible consequence of the failure to distinguish types of income distribution is the implication that projects built in economically depressed or low income regions automatically contribute to a national objective of achieving a more equal distribution of personal income. This implication occurred in the volume by Maass and associates in the discussion of trade-offs between national economic efficiency and regional income redistribution [3, ch. 2]. It now is apparent that direct farm program benefits going to our lowest income states often accrue mainly to the more affluent people both within those states and in the nation. The beneficial effects of water projects in low-income regions could be distributed in a similiar way.

Appraisal of a Regional Orientation

We now turn to some issues, activities, and experiences relating to effects of projects upon regional economies Up until about a decade ago, the principal concern of economists about water resource development was whether agency practices in estimating effects of the projects were consistent with criteria for increasing national economic efficiency. This still is a major concern. However, beginning with Senate Document 97, published in 1962, official Federal policy was to encourage evaluation of projects in terms of a number of objectives, including regional economic development. Agency practices in benefit-cost analysis did not change drastically in response to the new policy—in fact, major reorientations in agency practices since 1962 have occurred only in the Corps of Engineers' proposed water resource development projects in Appalachia, and these practices were more in response to the interpreted goals of the Appalachian Regional Development Act of 1965 than to SD-97. Nevertheless, the procedures developed by the Corps threaten to become a part of the standard operating procedures of all agencies and for all regions; and, because of that threat, this brief account and assessment is limited to some notions underlying these practices.

The central element in the proposed procedures is an assumed expansion effect due to the projects. This is a new kind of secondary effect—not "stemming from" or "induced by," as defined in the Green Book, and not a multiplier effect relating to regional export base theories or interindustry analysis. Rather, this new creature arises mainly from a projected expansion of primary or user benefits of water project services consistent with the interpreted goals of the Appalachian Regional Development Act. If the goals of the act are assumed to be (1) rates of regional development consistent with achievement of per capita personal incomes of people in Appalachia equal to that of people in the rest of the nation by the year 2020, and (2) job creation within Appalachia at rates necessary to employ the existing labor force and the natural increase thereof, then something phenomenal in the way of added economic activity within the region would be required within the next 50 years.[1] With three additional assumptions, all of this expanded economic activity net of associated costs of private capital investment could be attributed to the water resource projects. These assumptions are: (1) Investments in water resource development are perfect complements to the aggregate of all other investments, public and private, necessary for achieving the goals of the act; (2) the public component of these investments will be made regardless of the amount invested in water resource development; and (3) the private component will be made if the water resource projects are built. The assumed fixity in relation between proposed investments to develop water resources and other investments is as absolute as is the assumed necessity for accomplishing the goal of the act. The two become related imperatives.

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[1] These correspond approximately to the first category of goals of the act, as discussed in the main report of the Office of Appalachian Studies [6, pp. IV–4 and IV–5].

One could grant that if expansion in economic activity within Appalachia must take place in locations specified by the Corps of Engineers—i.e., in the vicinity of the proposed water projects—development of some flood protection and industrial water supplies may be necessary. However, this approach ignores the possible existence of alternative locations within Appalachia for expanded economic activity that are not hampered by water supply or flood hazard problems. Also, even if water resource problems were the kind of obstacles supposed by the Corps, the basic approach assumes away the possibility of the existence of even more important obstacles to the economic development of Appalachia in accordance with the assumed goals of the act.

Most of the major ideas for the Corps approach in evaluating water projects in Appalachia were provided by Spindletop Research, Inc. [4].[2] In turn, Spindletop claimed a major source of their ideas was the unbalanced growth doctrine as presented by Hirschman in his discussion of investment for economic development in underdeveloped countries [4, phase 1, pp. 12–15]. This doctrine states that, in a growth process, sectors of an economy advance unevenly, and this very unevenness is the source of investment incentives underlying growth. It is a conception of growth arising from disequilibria—a seesaw produced by excessive investment by some sectors (and subsequent catching up and "over-investment" by the other sectors). As applied to public sector investment for economic development, the implication of the theory is to choose those investments with the best prospect of creating external economies (or investment incentives) to the private sectors. Hirschman sets forth a clear warning about the possibility of lack of success of some public sector investments in some locations within a country in inducing private sector investments [1, pp. 92–95].

The Spindletop group seemingly interpreted Hirschman's unbalanced growth theory negatively—that lack of investment in particular sectors of an economy acts as a "bottleneck" or near absolute deterrent to further development. This, along with the implied complementary relations among investments, is the basis for the ring of authority in the Corps' expression of the necessity for particular water resource projects. Although this "bottleneck view" of the unbalanced growth doctrine, I believe, in erroneous, the more serious error was an application, without modification or adjustment, of the unbalanced growth theory to an economically depressed region, such as Appalachia, within the United States. Growth is less geared to a larger economic setting in an underdeveloped country than in an underdeveloped region such as Appalachia. Urban-industrial development within a single region must compete with urban-industrial development elsewhere in the national economy. My hypothesis is that all of the proposed public investments specified in the Appalachian Regional Development Act, if made, would not eliminate this comparative disadvantage of the region for urban-industrial development.[3] In partial support of this hypothesis, I suggest that most of the instruments provided by the act long ago were available or were used in the Tennessee Valley portion of Appalachia, yet that area does not appear to be developing at the rate necessary for it to catch up with the rest of the nation in per capita incomes within 50 years. In fact, according to census reports for 1960, the percent of the families in Tennessee with incomes below $3,000 exceeded that for West Virginia (38.3 percent, compared with 32.6 percent).

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[2] Some responsibility for the approach taken must be attributed to the Harvard study [3] completed in 1962, especially to the orientation toward regional economic objectives. Other contributions to this approach, both conceptual and empirical, are too numerous to mention.

Any methods of estimating contributions of water projects to regional economic development will provide erroneous results if based upon mistaken conceptions of regional economic development and of the role of water project outputs or services in that development. The unbalanced growth doctrine may provide an adequate explanation of economic development of the nation, or of particular regions. However, the specific public and private sector investments contributing to these processes are yet to be determined. Thus, the knowledge base necessary for developing defensible procedures for estimating the contributions of water projects to regional economic development does not exist This absence of knowledge is a major reason professional economists are largely ignored in the process of evaluation, authorization, and construction of water projects. To the agencies that want to construct water projects and to the people who want them, projects are considered economically justified in the absence of definite proof to the contrary.

A Concluding Assessment

After about 30 years of activity to develop and improve methods in benefit-cost analysis, where do we stand? What have we accomplished and what remains to be done? My remarks up to this point emphasize the lack of knowledge of regional development necessary for specifying methods for measuring the more dynamic effects of water projects. Perhaps we should approach the matter differently and ask if we have developed defensible methods for measuring the lesser dynamic effects of water projects. My contention is that we have not.

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[3] It is not my purpose to develop alternatives to the provisions of the Appalachian Act—however, my approach in such an endeavor would be a direct and major attack upon the human resource problems of the people in the region with a minimum of attention given to developing physical resources.

If we know how to estimate national efficiency gains from water projects, we have not been successful in getting this knowledge established in agency practices. Documents such as the Green Book and the special task force report, as well as agency directives, define primary benefits as net (direct) user benefits of project services. Then these benefits, net of project costs, are purported to represent gains in national efficiency (income). Additional gains in national efficiency are said to be the employment of resources that would be unemployed without the projects. The possibility that primary benefits, as defined, may be inconsistent with the national efficiency objective is not recognized. Agency procedures would count net income to farmland development in the benefit column of the national accounts without an adjustment due to induced interarea or interindustry distributional effects or to the added cost of farm programs. The interarea or interindustry distributional effects would be more severe for products with the most inelastic demands, such as farm products. However, inland navigation displaces some rail and other transportation services, public power displaces some private power, public recreation displaces some private recreation, etc. We need to know what fraction (if any) of primary benefits, as presently defined, should be entered into national efficiency accounts. The portion of primary benefits not entered in the national efficiency accounts would be distributional effects—those project benefits accruing to one area at the expense of one or more other areas, or one economic sector gaining at the expense of another. But there are other income distributional effects of the projects. We need to know the national employment effects and the regional location of these effects, the position of the primary and secondary beneficiaries on the national personal income distribution scale, the position of the losers on this scale, and the division of project effects into those consistent with national social objectives and those contributing only to a regional self-interest objective.

Given this state of our knowledge, efforts to develop procedures relating to "regional dynamics" of water resource development may be premature. A baby should not be expected to run before it has learned to walk.

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Estimating the Effects of Water Policies in the West*

HERBERT H. STOEVENER

THE topic of this paper continues to be timely. After decades of analysis of public investment in western water resource development projects, considerable work remains to be done. Public, especially Federal, involvement in natural resource allocation appears to have been increasing during the recent past. Since 1965 Congressional action has concerned itself, for example, with water quality management, additions to the national park system, the protection of estuaries, and the preservation of wild and scenic rivers. The Land and Water Conservation Fund has been established, and state and national planning for outdoor recreational developments has been encouraged.

It will be noted that the above list of actions taken at the national level is not necessarily consistent with the traditional role of the Federal Government in water resource development in the West. This list appears to be biased in favor of the so-called "quality of life" objectives, in contrast to those served by the traditional public investment policy.

Furthermore, as the result of an executive order, the rate to be used for discounting future costs and benefits in Federal water resource development projects has been raised substantially during the recent past. Since much of western water resource development has been of the type requiring high initial capital outlay and producing benefits over a relatively long time span, the general effect of raising the discount rate is to lower the benefit/cost ratio by which projects are evaluated.

Finally, and most recently, the Water Resources Council has published a report [1] suggesting new procedures for the evaluation of development projects. The outstanding features of this report appear to be (1) emphasis on the concept that public investment in natural resources may also serve objectives whose achievement is not readily reflected in the national income accounts, and (2) a set of suggestions for comparing the costs and benefits associated with pursuing these other objectives.[1] It is of interest to this discussion that the report recommends specifically the consideration of a regional development objective.[2]

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[*] Oregon Agricultural Experiment Station Technical Paper 2749.

[1] I am not entirely in agreement with the procedures suggested by the Special Task Force to deal with this problem. However, this issue is not relevant to those discussed here.

[2] Burl Back, in earlier discussion of this session, raised some important questions about "regional development" as a relevant national policy objective.

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The above material has been presented to support the argument that future work in the estimation of the effects of water policies on the regional economy of the West will not have to concern itself only with the traditional kinds of public investments made in the area, but will be more and more concerned with the shifted emphasis in national policy. If the above inferences are correct, it may be appropriate to distinguish in our analysis of the effects of water policies in the West among the purposes that these policies are to serve. This proposal is intended to contribute to the usefulness in national and regional decision contexts of the many empirical estimates that will have to be developed in the future. I propose to focus our discussion on three kinds of national policies: (1) those that have regional development as a national objective, (2) those in pursuit of some other national goal, but contributing to economic development as perceived by the region; and (3) those directed at other national aims that are inconsistent with developmental objectives of the region.

Western Regional Development as an Objective

It is difficult to generalize for an area as large and diverse as the semiarid region of the United States. Growth rates differ among states within the region and among areas within the same state. Similar differences exist with respect to idle capacity in the labor force. Presumably, differences also exist among areas in the West in the response of regional income to investments in natural resources. It is conceivable that national natural resource development programs will be employed in the future with the specific objective to enhance economic development of certain areas in the West. For the region as a whole, one might expect that the overall effects of such specific programs would be of secondary importance.

From the standpoint of research priorities, it is important that additional information be developed on the relationship between various kinds of natural resource development programs and their contribution to the development of regions with various economic characteristics. An associated problem is the specification of criteria by which development regions can be delineated.

Regional Development as a By-Product of Other Resource Policies

During the past, water resource development projects in the West have enjoyed vigorous public support in the region. Such support is likely to have arisen from two sources.

First, the primary benefits made available by many projects have generally been underpriced. The public goods nature of many benefits has resulted in making them available at a zero price. Understatement of the capital cost of projects by using too low a discount rate has been one reason for pricing project outputs too low when reimbursement by beneficiaries has been required. The opportunity costs of the water in water resource development projects have seldom been considered. These matters have been discussed elsewhere (see, for example, [2]). It is more important for the purpose of this discussion, to turn to the second source of public support of water development projects in the West.

This source has customarily been referred to as the existence of regional secondary benefits. These benefits accrue because of increased input requirements for the production and marketing of the goods and services produced by the project. They are measured by the increases in payments to primary production factors in the region under consideration. It is generally agreed that these benefits should enter into the national account only under specific circumstances, as they are likely to be offset by negative effects elsewhere in the economy. This, however, makes them no less real from the regional viewpoint. This kind of regional benefit has been an improtant result of traditional water policies in the West.

Studies, too numerous to mention individually, have been conducted in the West to measure the impacts on local economies of selected natural resource development projects. Such studies have concerned themselves with many kinds of projects or programs, and the size of the region studied has ranged from one smaller than a county to large river basins including several or parts of several states. Undoubtedly, the results of this work have generally been useful for the specific purposes for which it was undertaken. However, individually these studies must fail to provide the answers to the broader questions raised by this paper. For example, we have learned very little that would permit us to generalize about regional impacts when there are differences in the types of resource development projects that may be undertaken. Similarly, we are still unable to be definitive about regional effects when the structure of the area's economy is a variable. The relationships between the size of the development project and the size of the geographic area is yet to be determined, as are the relationships between the region in which the development project is located and the rest of the world.

Perhaps it is possible to study systematically the results obtained in work on this subject in order to gain some insights into the broader questions raised here. An alternative strategy would be to study these relationships directly.

The principal published work to take this latter approach is that of Haveman and Krutilla [3], who undertook their study for another reason, namely, to estimate the social costs of water resource development projects during periods of unemployment and idle industrial capacity. Nevertheless, their conclusions shed some light on the topic under discussion here. They concerned themselves with estimating the direct and indirect effects, in terms of industrial and occupational requirements, resulting from the construction phase of twelve types of water resource development projects. Engineering cost estimates were used to derive the on-site requirements for materials and labor. These data were supplemented by the use of the 1958 national input-output model and by a matrix of occupational coefficients by industry, constructed from Bureau of Labor Statistics data, in order to derive the estimate of indirect effects.

The study makes quite clear that, among water resource development projects, stability and diversity exist with respect to their effects upon industrial and occupational groups. For example, durable goods manufacturing generally makes a considerable claim upon project costs. In no case does the percent of total gross output required from this industrial sector fall below 20. Yet the output requirements from this sector per thousand dollars of project costs range from $265 in the construction of revetments to $1,113 for powerhouse construction.

Similar observations can be made about the distribution of the labor demands. For almost all project types, the largest percentage of labor requirements is filled by the "craftsmen, foremen, and kindred workers" group. On the other hand, inputs from this occupational group range from 20 percent of total labor costs for dredging to 44 percent for large multiple purpose projects [3, Table 7]. Furthermore, the effects of these projects are quite different when off-site labor requirements and indirect production effects are taken into account, in contrast to being concerned only with the allocation of project costs to industrial and occupational groups. The above estimates of 20 and 44 percent change to 15 and 61 percent respectively, when the latter basis is used for calculation (computed from [3, Table 6]).

In the context of the discussion of this paper, the estimates of the regional effects derived by Haveman and Krutilla are no less interesting. After analyzing the effects of the twelve types of water resource development projects up on each of ten U.S. regions, they conclude in part [3, page 65] that, with the exception of the Mid-Atlantic and East North Central regions, "the industrial demands placed on the region in which the water resource projects are built are primarily in the categories of trade, transportation, and services." Other industrial demands, primarily for durable goods, favor the Mid-Atlantic and East North Central regions, regardless of the location of the project. Furthermore, there are significant differences among regions in the amount of labor costs retained in the region in which the project is located, given the same type of development project. Similarly, for the same region, different proportions of total project costs are spent locally when the type of project is the variable. For example, for large multiple purpose projects, 52 percent of total project cost is retained locally as labor cost when the project is located in the Kentucky-Tennessee or Mountain regions, compared with 65 percent when situated in the East North Central region. For the West Coast, the numbers range from 44 percent to 55 percent for large earth fill dams and large multiple purpose projects, respectively.

We must hasten to reemphasize that this study concerned itself only with the construction phase of water resource development projects. Consequently, its results should be taken only as an illustration of the types of effects obtainable from such projects. Nevertheless, it appears justifiable to conclude that water policies as analyzed here may be quite discriminating in the manner in which they affect regional growth.

This matter may be irrelevant from the national viewpoint if, as assumed in this section, national policy does not pursue regional growth as an objective. Growth may be an objective of the region, however. I suggest that resource development planning might make allowances for these divergencies between national and regional viewpoints. My general suggestion for implementing this is to include regional interests more than is done currently in the cost sharing for water projects to be developed in the region. I am aware of at least some of the difficulties involved, but I believe that institutional design might be employed productively in this area. The decentralizaton in decision making that would result from regional or local participation in this manner would serve to channel information that currently can reach decision-makers only through political processes. Opportunities would be provided for making national policy objectives consistent with objectives as perceived by the region. Incentives could be provided to locate projects for the production of benefits relevant to the national account in those areas in which their production is most nearly complementary to the achievement of regional objectives. Similarly, a mechanism would be provided whereby project contributions to local objectives would enter into the choice of the types of projects to be undertaken in a region.

Directly related to the above comments is the final subject yet to be treated, namely, the case in which national policies are competitive with regional growth objectives.

Regional Development Competitive with National Resource Policies

As indicated earlier, recent trends in Federal involvement in water resource planning seem to favor the production of those national benefits not necessarily resulting from the traditional kinds of public investments in natural resources. If the latter policies lead to the kinds of regional impacts discussed here, one might speculate that the newer emphasis upon preservation of natural resources in their current state would not have effects that regions perceive to be positive. As a matter of fact, to the extent that developmental opportunities need to be foregone, such policies might make negative contributions to the regional account.

The establishment of the National Wild and Scenic River System is an example. The rivers for which national benefits from perservation are likely to be high are those located in relatively undeveloped regions. Non-development of these rivers may be very competitive with growth objectives of the region.[3] My recommendation for allocating costs between national and regional accounts holds also for this case.

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ROLE OF TRANSPORTATION IN AGRICULTURAL MARKETING AND DEVELOPMENT

CHAIRMAN: ROBERT RAUNIKER, UNIVERSITY OF GEORGIA

Transportation and Regional Development in Agriculture

T. E. NICHOLS, JR.

TRANSPORTATION has long been recognized as a strategic factor in economic growth and social change. Readily available, low-cost transportation makes it possible to bring raw materials from the mines, fields, and forests to the factory to be transformed into desired products. Likewise, dependable transportation makes it possible for these factories to supply finished products to their customers where and when they are needed and in the form and quantities desired. Without an efficient, well-managed transport system, the growth and development of an economy and/or region is adversely affected. The purpose of this paper is to discuss in general how transportation and agricultural development are interrelated in both the factor and product markets. By examining the recent innovations in rates and equipment among the various modes of transportation, an effort will be made to explain the interrelationship of these changes with the shifts in regional agricultural production patterns. Attention will also be focused on transportation changes and how they may be expected to alter the efficiency, output, and competitive structure of the agricultural industry in the future.

Importance of Transportation to Agriculture

The location of economic activity is not randomly distributed among certain regions of a country or areas of the world. Rather the location of economic activity is determined by a number of factors, such as regional endowment of resources, production functions for intermediate and final products, transfer cost functions, and demand functions for the final product. The mix of these factors in one area relative to another influences to a large extent both the direction and extent of growth and development in the region.

Because of special characteristics of its products—perishability, seasonality, bulkiness—agriculture is uniquely dependent on a dependable and flexible transportation system. The importance of transportation costs in agriculture is evidenced by the fact that they account for over eight percent

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of the wholesale value of total farm product shipments.[1] Transportation costs as a percent of wholesale value are much lower in agriculture than for mine and forest products, but they are more than double that for manufactured goods. With agriculture, there is quite a variation in the share of the sales dollar that goes for transportation services—the ratios ranging much higher for perishable than for semiperishable products. Watermelon growers pay nearly 38 cents of each sales dollar for transportation—about half as much as they receive for the product, while the shipping charges for feed grains average about 15 percent of the wholesale price of the products. Increases or decreases in transportation charges consequently have a greater potential impact upon the farmer than in most areas of production.

Changes in transfer costs and services are also of significant importance to processing firms. Individual firms, when evaluating the economy of alternative plant location sites, consider outlays for transportation services incurred in the acquisition of raw materials and distribution of products as costs. The aggregative effect of these individual plant location decisions ultimately determines the spatial structure of an industry.

When businessmen select production sites or seek new locations for their plants, they attempt to select one that will enable them to operate at the most profitable level, typically by minimizing total costs. Even though transportation costs are only one component of these costs, they are an important component of the total cost that is being minimized. Relationships of primary importance exist between outlays for transportation and accessibility to sufficient supplies of raw materials and good markets for products that will enable efficient operation of the plant to be built. Sometimes input or raw material access is dominant in determining the location of an activity and sometimes market access; sometimes neither is dominant, with the result that the location will be at intermediate points.

In general, early stages of processing are material-oriented and later stages are market-oriented while intermediate stages are relatively "footloose" as to transfer considerations. Flexibility in the combination of materials used or products turned out increase the area of locational choice and frequently favor orientation to material sources or markets rather than intermediate points. In any given case, the choice of location will depend on the relative importance of various cost factors as well as noneconomic considerations.

Specialization and Regional Shifts in Agriculture[2]

Over the past several decades, a revolution based on science and technology has altered greatly the structure and performance of U. S. agriculture. Today, American agriculture is characterized by a very high degree of regional specialization.

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[1] This value represents freight charges in 1959, the last year for which these data were available.

[2] This section draws heavily on [2].

This high degree of specialization is possible only because of the ease of shipment of farm products from one area to another and the ease of receiving in return manufactured products from other regions. With specialization has come increased productivity in agriculture and industry and a higher level of living for consumers in the United States.

Agriculture has not always been organized in this highly specialized fashion. Going back one hundred years or more, we find a much different type of organization in the early stages of expansion of agriculture across the continent.

Prior to 1800, the northeastern section of the United States was an agrarian economy, largely subsistent and self-sufficient in character. The economic system of the South was much different, based largely upon specialized production and export markets. Principal crops consisted of naval stores, cotton, tobacco, rice, and in earlier years, indigo. The West was still undeveloped, with the frontier at the Mississippi River.

The lack of an adequate transportation system within and between regions served as a critical bottleneck to development of commercial agriculture and industry. In the North, the most far-reaching development in transportation was the opening of the Erie Canal in 1825. The canal connected the Great Lakes with the Atlantic seaboard and had a marked effect on agricultural prices and land value, both in the North Central states and in the upland regions of northern New England. Before the canal opened, it required 20 days to transport a ton of freight from Buffalo to New York City overland, at a cost of $100; after the canal was opened, the time was cut to eight days and the cost to $15 a ton.

Water transportation provided a cheap method of moving products, and river and canal transportation reached the peak of its development in this period. In 1830 there were only 23 miles of railroad line in operation; by 1840, this had increased to 2,800 and by 1860 to 31,000. In New York State, canals continued to carry more tonnage than railroads until 1869 when the first transcontinental railroad was completed.

The impact of the development of the railroad upon agricultural and industrial expansion was great. Grain production shifted westward rapidly as families left the rocky, irregular, eroded fields in favor of the more fertile productive land. Livestock followed soon thereafter. The group of industries closely related to agriculture also moved westward, since the processing activities were often weight losing. The Atlantic coast states from New York to Virginia produced in volume 65 percent of the flour in the country in 1840, but only 57 percent in 1850 and 39 percent in 1860 [4, p. 226]. There was a similar shift for meat packing and slaughtering, not only from east to west but also from the Ohio Valley to the Lakes region. Chicago rose to international fame as its pack of pork tripled within the span from 1852 to 1860, while that of beef doubled.

The railroad and waterway expansion of the 1850's opened to many farmers and processors a choice not only for final destination for their product, but various routings to that point. As a consequence, marketing patterns changed radically.

Impact of Transport Changes on Agriculture

The progress of technological changes affecting agriculture involves innumerable and subtle interrelations that are often difficult to trace and document. This stems from the adoption of new inventions and innovations, which is generally slower in agriculture than in industry. However, technological improvements in transportation, for the most part, have been readily adopted by both carriers and users. Because of their rather sharp impact on geographic and commodity relationships, they are more readily identified and measured than are other technical changes, which are evolutionary in nature, occur in small increments, and are significant only in the aggregate.

The primary results of technological change in transportation have been improved equipment, routes, and systems. These changes, in turn, have been effective in bringing revisions in the rate structure, which has traditionally exerted considerable influence on the location and structure of producing areas, processors, and markets.

Effects on Location

When technological change reduces the cost per unit of output of a particular factor, the relative weight of other factors influencing location, such as processing cost differentials, usually increases. Thus, innovations in transport equipment and facilities and changes in freight rate structures exert considerable influence upon the location of industry. For example, refrigeration and the increasing use of trucks for inshipment of livestock have contributed to a deconcentration and decentralization of the meat industry with an increasing degree of specialization by individual firms. The refrigerated rail car provided the first stimulus toward the development of the major slaughter and meat-packing centers of Chicago, Kansas City, Omaha, Sioux City and St. Paul. The existence of rail terminals and major livestock concentration points facilitated their development as major meat-packing centers when first icing and later the refrigerated rail car came into widespread use.

The increasing use of motortrucks and the construction of all weather farm-to-market roads during the 1920's and 1930's led to a major shift in the meat marketing industry. It lessened the reliance upon converging rail lines for the inshipment of livestock at the traditional terminal markets. In addition, mechanical refrigeration on both rail cars and trucks contributed to a greater intermodal competition in the transport of fresh meat. Slowly a new economic pattern evolved. Packing plants moved increasingly into the producing areas nearer to their sources of supply. Small independent and specialized slaughter plants taking advantage of the unique markets offered by the retail chains gained an increasing share of the market. Between 1947 and 1963, the share of the total meat packaging industry accounted for by the four largest firms declined from 41 percent to 31 percent [7]. Further deconcentration, however, may be slowed due to economies of size in processing and distribution. Rapid technological advances in aircraft design and centralized packing promise to stimulate revolutionary changes in traditional concepts of physical distribution. It appears that cutting meat to individual specifications and air freighting it to central markets will be economically feasible within the next 15 to 20 years.

Over the last two decades, it has become clear that distance is no longer a limiting factor in the development of specialized meat production. Improved transportation through a vast interstate network of superhighways has hastened feedlot relocation out of the Corn Belt to the Southern Plains, stretching from West Texas to Nebraska. There is ample evidence that the trend toward further relocation of feedlots and packing plants will continue.

Dramatic shifts have also occurred in the location of processing plants for grain and grain products as a result of the introduction of "cost-oriented" rates in the early 1960's. For many years, flour mills were located at intermediate or transshipment points between wheat producing regions and flour markets [11]. The transshipment orientation was supported by a structure of transportation rates based on a value of service criterion. Utilizing intransit milling privileges, alternate milling centers could experience the same total transportation costs; however, loading and unloading costs could be eliminated if processing took place at points of transshipment. Thus, flour mills tended to locate along major railroads near their sources of wheat supply.

Elimination of the transit privilege and the rate reduction given by the railroad on wheat and other coarse grains, without similar reduction on flour or other processed commodities, has provided economic incentives for mills and other grain processors to relocate nearer the major consuming areas. The relocation of flour, feed, and soybean mills as a result of freight rate adjustments and expanded markets has been widespread throughout the eastern and southern states in recent years. As long as consuming areas are separate from producing areas and transportation rates for products are higher than those for raw materials, further reorientation of processing plants to consuming centers will likely occur.

Effect on Firms

Equipment and rate innovations can and do alter scale relationships of firms that affect their efficiency, output, and competitiveness. The changes in transportation costs for feed ingredients have usually been stressed in any economic analysis of the price of poultry feeds in the South versus the Midwest. Bluestone [1, p. 32] attributed the relative decline in the cost of poultry rations in the South over the previous 15 years to the navigational improvements in the inland waterways that tie the Southeast to the surplus corn producing areas of the Midwest.

Kriesel [5] described the decline in costs of feed delivered to poultry producers in the Southeast as initially arising from introduction of water transport of grain on the Tennessee River, accompanied and later superseded by the growing role of motortruck transport and, most recently, by introduction of a new rail freight service that slightly undercut the truck rates.

In an economic analysis of changes in the structure and location of the market egg industry, Morrison [6] found that lower feed prices due to freight rate differences between regions contributed to the Southeast's competitive advantage in eggs as well as in broilers.

Thus, it appears that relatively lower freight rates on feed, which represent approximately 60 percent of the cost of producing broilers and eggs, has been an important factor in the rapid expansion of poultry in the Southeast.

Multiple-car rates and especially train rates favor large scale operations both at points of origin and destination. These innovations in rate making, if widely adopted by the railroads, could have a significant influence on the size and number of firms in the industry. Advantages accruing to the grain processing industry will be available only to those firms that have sufficient unloading and storage capacity to make consistent use of high capacity hopper cars on a train load or multiple-car basis. Obviously, small elevators at points of origin and small feed mills at destination are at a disadvantage in the movement of grain in large lots.

There is also evidence of savings in per unit transportation costs. Felton indicates that out-of-pocket costs for shipping grain in a standard boxcar are about 8.50 mills per ton mile [3]. Experience of the Southern Railroad, shipping coarse grains from Cincinnati, Ohio, to Raleigh, North Carolina, in five-hopper car units, indicates costs of about 5.73 mills per ton mile. Shipments of 100-hopper cars from central Illinois to New Orleans can be performed at about 1.50 mills per ton mile. Thus, there appear to be significant opportunities for reduction in the cost of transportation of grain whenever the volume of grain between origin and destination is of sufficient magnitude to justify continuous shuttling of a unit train between these points.

While some shippers of agricultural products have realized substantial savings on transportation charges, benefits from intermodal competition appear to have been limited to some extent for others.

Impact of Competitive Pricing

The selective implementation of high volume, nontransit rates can make an intermediate location less profitable for milling and storage, but can also leave other regions disadvantaged because they do not automatically receive the same low rates.

Seaver has observed that ". . . in face of severe competition from the Southeast, it is doubtful that the Maine and Delmarva broiler producing areas can survive over the next ten years. Their ability to do so will depend to a great extent upon feed freight rate relationships between the Northeast and Southeast and upon the likelihood of the Southeast finding some profitable alternative farm enterprise other than broilers and eggs . . ." [8].

Concern has also been expressed both about the changes in pricing of transportation and the adequacy of service [10]. Proponents of traditional rate relationships argue that, if branch lines have inadequate capacity to handle the "Big John" cars or other equipment, they may be expected eventually to discontinue operation, with a resultant financial loss or burden to these newly created "out of position" firms. As specialized equipment and fewer multiple purpose cars become more prevalent, the ability of the carrier to move seasonally produced and highly perishable items may also become more restrictive. Ownership by the volume shipper of a substantial portion of the limited supply of cars could adversely affect both the small shippers and receivers.

The impact of changing prices, services, policies, and rate structure upon market structure and the competitive position of agriculture in the various regions is and should be a major concern to everyone. One can build a strong argument that a pricing policy that maximizes net firm income does not necessarily result in the optimal allocation of resources in other industries; or it may not necessarily represent a maximum net social gain. To those firms and industries that are disadvantaged by the greater rate making freedom on the part of carriers, this concentrated impact on their own competitive position has been far more immediate and apparent than the savings in transportation costs that are being brought about by improved technology and increased competition. Disruptions of established production, processing, and distribution patterns have significant short-run costs for economy, adversely affecting the value of existing facilities and perhaps in extreme cases even forcing their abandonment [9].

But attempts to preserve rate structure and services established to fit conditions that no longer exist also impose important long-run costs on the economy as a whole. The offsetting losses to some firms, communities, and regions should be set against the gains to other groups from competitive rate adjustments and the transition to competitive pricing.

Cost of production and distribution must be considered together. Economic efficiency is concerned with the total allocation of all resources, and the location of producing, processing, and marketing facilities is one element, albeit a very significant one, in determining total economic cost. In the past, resource cost differentials have been concealed to a great extent by use of group rates for shippers. Production and marketing areas became more extensive and more expensive in terms of resource utilization than would have been warranted had rates for moving the same product reflected the true costs of providing the service. The fact that costs were equalized to provide producers access to several alternative markets obscured the higher total cost of uneconomically located production and processing facilities.

Competitive pricing for farm product transportation services tends to force rival carriers to supply each shipper with service at its cost to them. When competition is present, it also tends to allocate traffic to the modes of transportation able to haul most efficiently. Over the longer run, the geographic differentials that are reestablished by competitive pricing foster locational patterns that minimize total economic costs, including the cost of transportation. Where long standing geographic patterns are uneconomic, this process cannot be carried out without transitional readjustments which might inflict hardships on individuals and some economic cost to society as a whole.

Summary

Transportation, as one of the factors of production in our economic process, has played a dominant role in the structural evolution of U. S. agriculture. Likewise, the development of transport facilities has made an important contribution to our nation's welfare and to our individual standard of living. With transport facilities of early America, it was generally uneconomical to move commodities of low value per unit of weight for long distances, and the inhabitants of each region had to become relatively self-sufficient. Long-distance trade, even if possible, was not practical—particularly for bulky commodities. Today, vastly superior transportation equipment has greatly reduced the cost of moving people and goods, facilitating the production of goods and services in locations with lowest production costs. From an economic standpoint, there have been four major revolutionary innovations in transport technology since the 1820's. Each innovation has played a significant part in the regional development of agriculture by making some locations economically obsolete but opening up investment opportunities in new areas. The first two were the canals and railroads, whose effect was toward the concentration and centralization of production, processing, and marketing. Later came the motor truck and the airplane, which set in motion decentralization and deconcentraiton tendencies, particularly in the production and processing of livestock.

Although dramatic changes in transportation have taken place, technological advances in transportation are certain to continue. These changes will affect both agricultural and nonagricultural industries. To the extent that agricultural firms adjust to take advantage of changes in transportation, greater regional specialization will occur. This regional specialization is consistent with agricultural development and, indeed, with total economic development.

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Economic Considerations in Rate Making and Rate Structures for Farm Products

JAMES H. LAUTH

THE goods that farmers grow and sell must be transported and delivered in the form and at the time and to the places that consumers desire. But the transportation of farm products does more than create the place utility that gives them real value. Without transportation we would have to spend most of our time raising food—and the food would be limited to the kinds that grow in the climate and soil of our neighborhoods.

Our highly developed transportation system eliminates the need to produce the bulk of our food close to our population centers and permits a high degree of regional specialization of farm production. Our grain, cotton, citrus fruits, and many other crops are produced in those areas best suited for their production by soil, climate, and topography and to which scientific farming and modern farm machinery can be applied. The result has been to make possible tremendous economies in production and drastic reduction in the cost of food purchased by U. S. consumers.

The charges assessed for the movement of farm products, in terms of both the level of freight rates and the inter-commodity and inter-regional rate relationships, are vital to this regional specialization as well as to efficient utilization of resources so that the widest possible markets, domestic and foreign, can be attained at the lowest possible cost.

In this context, this paper will discuss the economic considerations used in the makeup of rate structures for the movement of farm products. It will deal mostly with the railroad transportation of unmanufactured (or unprocessed) farm products.

Basically, railroad rate making has given consideration to two pricing principles: (1) cost of Service, and (2) value of Service.

Cost of Service

Increasing competition from trucks and barges has firmly established the cost of providing rail service as an important factor in pricing rail services. For particular shipments, the level of railroad costs is influenced by: (1) quantity shipped, (2) distance, and (3) operating conditions. These factors have been adequately discussed in numerous publications and there is no need to repeat here.[1]

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[1] See, for example, [1, pp. 271–278].

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Railroad rate making must give consideration to the nature of railroad costs in pricing services, particularly in establishing the floor under which rates should not be offered. Rail costs are characterized by a huge "sunk" investment, a high proportion of fixed costs, and the existence of excess or underutilized capacity [4, p. 36–44]. The heavy fixed expenses in railroad plant cannot be adjusted with changes in traffic volume.[2]

These costs have to be met whether traffic moves or not. This makeup of railroad costs allows the use of incremental (out-of-pocket) costs in pricing rail services on particular segments of traffic. All rates do not have to contribute a proportionate share of overhead costs. The railroads are often better off with additional traffic than without it, even though the rate needed to attract the traffic contributes less than its proportionate share to overhead costs. That is, rates can be established at a level that provides only a small margin above the direct costs occasioned by the movement of an additional volume of traffic from A to B. The additional revenue from such traffic contributes to the overhead burden; improves railway net income; and, by spreading the burden of fixed costs over a greater amount of traffic, tends to hold down rates paid by shippers of other traffic in noncompetitive areas.

Interstate Commerce Commission "Rail Form A" out-of-pocket costs, developed for regulatory purposes, provides regional unit costs which, over the long-run and with average density of traffic, have been found to be variable with traffic changes. These costs include 80 percent of freight operating expenses, rents, and taxes (excluding Federal income taxes), plus a return of 4 percent after Federal income taxes on 50 percent of the road property and 100 percent of the freight equipment. They reflect the relative amount of transportation received by "average" regional shipments, and in so doing provide a measure of the differences in the unit costs for shipments of varying sizes in different types of equipment and for varying lengths of haul which, in turn, can justify differences in the rates charged.

The function of "cost-of-service" in rate-making, then, is to identify the minimum (out-of-pocket) costs so as to set the "floor" for railroad pricing and to provide a plane to which demand factors can be related. Rates are then established at various margins above that floor at levels that are responsive to demand factors (value-of-service) and that reflect such cost factors as quantity shipped, distance, and operating conditions.

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[2] Trucks and barges not only have lower investment costs but also substantially higher variable costs and and therefore can adjust more readily to changes in traffic volume. Rail variable costs are estimated to be about two-thirds of total costs, while for truckers they rise to as much as 90 percent, and for barge operators they account for perhaps 95 percent [4, p. 37–38].

Value of Service

Locklin defines value of service as the highest charge that can be levied without preventing a shipment from moving [3, p. 144]. He explains: "That limit is determined by no one factor. Sometimes the effect of the rate on the demand for the article sets the limit; sometimes the limit is the difference in prices in two places; sometimes it is the difference in cost of production; sometimes it is the difference in cost of production if the opportunity cost at point of destination is also included; and sometimes the limit is set by the cost of obtaining the commodity from an alternative source of supply. But whatever may determine the limit of the charge, the limit is real and cannot be ignored. It says to the railway manager who is making rates: Thus far shalt thou go and no farther." This factor, then, is the demand factor in the pricing of transportation, whereas the cost of service factor has been referred to as the supply factor [2].

One element of value of service pricing gives consideration to commodity value and tends to justify higher rates on a high-priced commodity than on a low-priced commodity where the two have similar transportation characteristics. A rate of $2.00 per hundredweight might well reduce demand (and therefore the movement) for wheat worth $2.00 per hundred weight at origin, whereas the same rate would hardly affect the demand (or movement) of a 100-pound television set worth $300.00 at origin.

The two more important elements of value of service pricing are market and product competition and intermodal competition (and intramodal competition, to a lesser extent).

Market competition as a pricing factor takes into consideration the economic and commercial conditions surrounding the production and sale of a particular commodity. Market competition plays its part in rate determination when new markets are desired to be developed for a particular region's production. The consideration that led to the Northern Line's reductions in westbound rates on spring wheat in 1965 was not competition from other modes of transport but rather competition from Canada in the selling of wheat in the Asiatic market. And the "inverse nature" (a higher rate for the shorter than the longer distances) was dictated, certainly not by cost considerations, but by the nature of the commodity pricing and marketing system. In the recent railroad proposal to reduce export rates on winter wheat from Texas, Oklahoma, and Kansas to California ports, the prime consideration is whether or not reduced transport costs (charges) will create new business to make U. S. wheat price competitive in the Asiatic market with other wheats, principally from Australia and Argentina. A further market consideration will be the potential loss of flour tonnage if a lower export wheat rate adversely affects the marketing capability of flour mills, at origin or destination, to sell in the West Coast markets. Although truck competition was significant, the key to the reduction in feed grain rates to the poultry industry in east Texas was the recognition that a lower delivered cost of feed would not only keep a market for feed from the Midwest but would help that market to grow and produce more poultry, use more feed and help the economy of the area develop and grow and use more goods and services.

Market competition also comes into the pricing formula when two or more producers of like or substitutable products compete for sales in the same markets. The western railroads have long maintained lower rates, distance considered, on fresh fruits and vegetables from western origins than the rates from less distant producing areas in Florida. Such rate-making serves the western railroads by achieving more competitive pricing of California oranges, for example, with Florida oranges, allowing production to be marketed in the distant eastern consuming markets.[3]

Probably the most important single element in demand (value of service) pricing is the presence or absence of intermodal competition. When the basic rate structures for most farm products were established in the early 1930's, intermodal competition was relatively insignificant. The rate structures thus established were primarily market oriented with little consideration given to the relationship to the cost of providing the service. Emphasis was placed upon development of a rate structure that would provide freedom of movement for the products of agriculture so that as many producers and processors as possible could reach as many markets as possible. Factors such as definite relationships between the rates on raw material and the products manufactured therefrom, equal treatment of large and small shippers, recognition of competitive relationships between producing areas and marketing areas by the inclusion of transit privileges in the rate, blanket rates, group rates, and proportional rates all characterized the rate structures thus established.

Following establishment of these basic rate structures, the railroads in the 1930's, 1940's, and 1950's increased the rate levels generally on an equal basis thereby maintaining the existing rate structure and competitive rate relationships.

However, since about 1958, by which time the railroads' share of transportation of total intercity freight movements had fallen to about 43 percent of the total, the railroads have started a drive to reduce rates in areas where they face competition from trucks and barges. These selective reductions, achieved through lowered unit cost of operation and to meet intermodal competition where it exists, have had far-reaching effects on the competitive relationships between producing areas and processors and the marketing system.

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[3] Truck competition is not a factor here, as over 90 percent of fruits and vegetables arriving in eastern markets from western origins are by rail.

Rate reductions given by the railroads in one area but not in a competing area because of lack of intermodal competition can cause loss of former markets if not offset by other economic advantages. Lower rates on raw products, which in many instances are less costly to transport than processed commodities, can—and do—cause relocation of processing plants to the major consumption areas. Unit-train rates and multiple-car rates offer vastly lower rates for the large-volume shipper, and thus can have a significant influence on the size and number of firms in an industry. Mileage rates, such as those now established on corn in the east, favor those located close to their markets. The old rate structure protected hundreds of small geographically scattered processors and handlers by equalizing rates within large origin and destination groups. Elimination of transit privileges creates advantages to those marketing or processing facilities located in the origin or destination areas and disadvantages to those at intermediate location [1, pp. 279-281].

The recent nationwide increases (ex parte 256 and 259) have been selective in nature by the establishment of lower increases on commodities in areas where there is intensive intermodal competition and higher increases in non-competitive areas, thus further widening the relationships between producing areas.

Although intermodal competition has increased considerably over the past few years, there are significant areas where railroads presently provide the only effective transportation service. Key factors of distance, volume, and nature of the commodity seem to be significant in minimizing the effectiveness of motor carriers as competitors in many instances. Motor carrier competition diminishes with increases in distance, e.g., fruits and vegetables from California to New York. Volume shipments, both in terms of amount per car and annual volume, tend to be captive to railroads, e.g., covered hopper car shipments and unit train shipments of grain and unit train shipments of coal and ore. Low value commodities move almost entirely by rail or barge. With respect to exempt commodities, many truck movements are curtailed by lack of commodities to haul into the producing area. The cost of motor carrier service in these instances would be simply too high, whether private or for hire, to permit movement. Barge carriers provide very effective competition to the railroads on volume, long distance, and low-rated commodities. Barge lines, though, are handicapped by their geographic limitations and restricted by frozen waterways in the winter and, in the case of some waterway systems, by low channel depth and lock limitations.

Some captive rail service examples are fruits and vegetables from the

West Coast to markets east of the Mississippi River; potatoes from the west (Idaho, North Dakota) to eastern markets; potatoes from Maine; wheat from Montana and part of North Dakota and South Dakota; wheat from Idaho; barley from North Dakota; grain to New England; grain to New York, Pennsylvania, New Jersey and Delmarva; cotton from California, Arizona and Texas to Carolina mills; and westbound transcontinental export grain.

Summary

Rail rates are not determined by a proportionate allocation of total costs to each shipment. In the aggregate, of course, total costs must be met; but total costs need not be recovered for each shipment because of the inherent nature of railroad costs—a huge "sunk" investment, a high proportion of fixed costs, and excess capacity in the railroad plant. Incremental cost pricing is economically sound under such conditions and is used to gain (or hold) traffic that otherwise would be lost to competing modes or would otherwise be unavailable for movement because of market or product competition.

The resulting rate structures are comprised of rates that vary, both within a particular commodity rate structure and among the various commodity rate structures, from levels that provide a small margin of revenue above out-of-pocket costs to those that provide revenue considerably over fully distributed costs. For example, in 1966 the commodity group "Nonmetallic Ores" returned a ratio of revenue to out-of-pocket costs of 101 percent and a ratio of revenue to fully distributed costs of 69 percent. The commodity group "Ordnance and Accessories" returned a ratio of revenue to out-of-pocket cost of 365 percent and a ratio of revenue to fully distributed costs of 277 percent. Farm products, for the same year, yielded a ratio of revenue to out-of-pocket costs of 124 percent and ratio of revenue to fully distributed costs of 93 percent.[4]

The determining factor that influences the level of particular rates above the "floor" is the railroads' response to demand. Demand comes principally from truck and barge competition and market and product competition. There have been a number of significant downward adjustments on farm products in recent years that were established as a result of intermodal competition. These reductions were achieved through lowered costs by operation by establishment of incentive loading rates, volume rates, and "bare bones" rates, which reflect more of a relationship to cost of providing service than the historic "value of service" rate structure. However, there are many areas of the country where sufficient truck or barge competition for farm products does not exist. In these areas, recognition of market competition is becoming more evident in railroad pricing of farm products. Because farm products are relatively low in value and are grown in areas best suited by soil, climate, and topography, rates must not be so high as to prohibit or restrict movement to national markets. Unlike manufacturing plants, the location of farming is fixed by nature and cannot, and should not, be restricted by the absence of truck or barge competition.

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[4] Computed by the Transportation Services Branch of Consumer and Marketing Service, USDA, in accordance with procedures outlined in I.C.C. Statement 2–68, *Rail Carload Cost Scales by Territories for the Year 1966*, and based on data contained in I.C.C. statements TD–1, *Territorial Distribution of Traffic and Revenue by Commodity Classes*, and TC–3, *Territorial Distribution of Carloads for Selected Commodity by Type of Car for the Year 1966.*

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Last year Montana was third among states in the production of wheat, which accounts for about seven percent of the total U. S. production. Montana also ranks third in barley production. These two grains are the major agricultural crops in the state.

Montana's calf crop totaled 1.4 million head last year. By coincidence, we shipped nearly 1.4 million head of cattle out of state. Some simple arithmetic illustrates the magnitude of the volume of livestock and grain as related to transportation and mode of transport. The latest information indicates that 65 percent of Montana's out-of-state cattle shipments are made by truck. An average shipment is moved slightly over 700 miles and contains 50 head per truck load [1]. This means that over 18,000 truck loads of cattle destined for out-of-state markets were made last year. Another 600,000 head are shipped by rail for an average distance of 718 miles.

Montana had a 124 million bushel wheat crop in 1968. Over 100 million bushels must eventually find their way to out-of-state markets. Although much is in storage at the present time, a 100 million bushel crop would fill 30,300 hopper cars holding 3,300 bushels each, or 606 trainloads of 50-hopper cars each. On the other hand, it would require 87 thousand super trucks (1,150 bushel units) to haul the same quantity. In recent years our barley crop has averaged 48 million bushels, which is equivalent to 14,500 hopper carloads, or 41 thousand truck loads of 1,150 bushels each.

Montana has major grain markets to the east and west. At some points in Montana, grain rates are the same whether shipment is to be made to eastern or western markets. Our primary terminals are Portland and Seattle to the west and either Minneapolis or Duluth-Superior to the east. Either one of these terminal markets may be from 700 to 1,100 miles from our producers, depending upon the origin of shipment within the state.

Pricing Transportation Service

Farm products, more than manufactured goods, depend upon transportation for the creation or preservation of their value. Place utility—the value added to farm products by moving them from where they are abundant relative to demand to where they are less so—constitutes a high share of their final price [5].

The average cost of transportation for grain in Montana is slightly over 30 per cent of the terminal market price. Consequently, any percentage increase or decrease in transportation charges has a much greater impact upon our agricultural producers than in many other areas where transportation charges are a much smaller percentage of the terminal price.

Ulrey [5] says, "Important though it is, the high ratio between transportation charges and final market values is not the most significant aspect of agriculture's dependence on transportation services." He adds, "Agriculture's demands upon transportation are seasonal, variable, and so unpredictable that they require a high degree of flexibility on the part of the carriers. Producers can control these uncertainties only to a very limited extent." However, wheat producers in Montana can exercise some control over the seasonality of marketing because there is enough farm storage in the state to hold slightly more than two years' production of wheat. Even with this alternative of farm storage, there is some seasonal pressure on carriers.

Importance of Transportation Service to Montana

Ulrey also says, "The emergence of strong and effective competition for any specific traffic movement depends on two conditions. First, the traffic must be sufficiently attractive to provide carriers with incentives to compete. Second, the relative advantages and disadvantages (including costs) of the service offered by competing carriers must provide shippers with effective alternatives. The *intermodal competition* that has already emerged from much agricultural traffic and is extending around a widening geographic periphery shows that alternative carrier types have both incentive and the ability to compete" [5, p. 4].

Intermodal competition, as described by Ulrey, has not been apparent to shippers of agricultural commodities in Montana. Its lack has led to frustrations of producers and merchandisers. Producers and shippers have felt that the traditional economic advantage of competitive pricing is not working toward their benefit in Montana. Advantage of intermodal competition lies in the pressure it brings on the carriers to underbid rivals for each haul. In only a few locations do rail carriers effectively compete with each other for grain in Montana.

The following reasons provided by agricultural producers in Montana were the basis of their frustrations in the mid-1960's.

1. *A discrepancy of rail grain rates within the state of Montana.* Wheat shipped from Havre, Montana, to west coast destinations was moving for 25 cents per hundred more for export than wheat from Bozeman, Montana, to west coast destinations when the distance was nearly the same [Table 1]. They were also upset because from Denver, Colorado, the freight rate to the Pacific North Coast was only 70 cents per hundred, while at Havre, Montana, it was 76 cents per hundred for export [3]. Harve is roughly only about two-thirds as far from the Pacific North Coast as Denver.

2. Producers were suffering from a lack of information on where their grain was going from Montana.

3. They were questioning the pricing of grain in the country on the basis of the Minneapolis price less freight.

4. They felt that there seemingly was no benefit to them from the cur-

rent equipment technology by rail carriers and trucking firms.

5. It was not apparent that they were receiving any benefit from some of the innovating rate making that was going on in other states that were producing and shipping grain.

6. The intent of the inverse freight rate for export was not well understood by a majority, and they felt their freight pricing was based more upon what "the traffic will bear" than in many other states.

It was into this framework of concern, frustration, and, in some cases outright anger on the part of some agricultural producers in the state that the Division of Agriculture at Montana State University launched a joint research and extension transportation project in the spring of 1967.

Challenge to Research and Extension

The basic challenge of this project was to determine what the real transportation problems were and what alternatives there were for adjustment in those areas that are deemed necessary after investigation.

Montana approach

Community meetings were held with agricultural producers and the grain trade. An advisory committee meeting was held that involved staff from the College of Agriculture, College of Engineering, Montana Crop and Livestock Reporting Service, Cooperative Extension Service, Railroad and Public Service Commission, Federal Extension Service, and the Upper Great Plains Transportation Institute.

It was determined that the major research emphasis should begin with the wheat transport problem. It should start by developing basic data and an inventory of the existing situation, since no one had adequate data upon which to base many of the arguments that were causing a great deal of concern.

The first step involved working with the grain trade to obtain grain shipment data in Montana. After working with the regional offices of the major companies and country elevator organizations, a mail questionnaire was approved. Data for fiscal year 1966-67 was obtained, and this was published in January, 1969; data for 1967-68 and 1968-69 will be published by the end of this year. Building on the experience and information obtained, a system has been worked out whereby shipment data will be obtained on a regular basis with the cooperation of the grain trade.

Seventy-seven percent of all grain shipped from Montana was by rail. Backhaul trucks handled another 14 percent and one-way trucks handled 9 percent. Indeed, railroads in Montana are the number one carrier of grain.

In 1966-67 rails hauled 83 million bushels of grain; 86 percent of it moved west and the remainder moved east. Of the 24 million bushels shipped by truck, 17 million bushels went to out-of-state markets—Minnesota, Washington, and California were the most important destinations. This data on destinations was the first that many producers had had on where their grain was being shipped.

This dominant role of railroads in the transport of Montana grain left some grain producers with a feeling of helplessness. If the value of the transport service is high to the user, the price can and will be high because the user has virtually no alternative method of shipping. The automatic question raised was: Without the competitive factor of intermodal competition, how is it possible to bring about any adjustments in transportation price that would be more palatable to the shipper of grain?

If the rail carriers are pricing their service from a demand orientation, and there is no effective competition, are they then charging what the traffic will bear? Consultations were held with the Montana Wheat Research and Marketing Committee, grain growers, grain trade groups, and with the rail carriers in an effort to determine what might be some of the alternativies in the Montana grain transportation situation. Obviously, the rail carrier of grain in Montana is not subject to a great deal of competitive pressure. Without the competitive factor, how can adjustments be made in transportation pricing?

Attention focused on four factors that would result in grain rate adjustments by rail carriers:

1. Increased tonnages resulting from lower rates.
2. Increased equipment utilization.
3. Reduction of accessorial services.
4. Blanket rate making.

The data indicated very little opportunity to increase tonnages with reduced rates for the state; the exception was the Northeast Crop Reporting District where 28 percent of the grain shipped from elevators was by truck.

Rail carriers admit to a very low equipment utilization. In merchandising of grain, considerable additional services are furnished by rail carriers that are not furnished by other modes.

The accessorial services of generous loading and unloading times, transit, diversion, and inspection stops are time consuming and are provided by rail carriers from Montana. Testimony in I & S Docket 8417 indicated a reduction of accessorial services could reduce turn-around from 19 days to 12 days from Wilbur, Washington, to Pacific Northwest ports. Such a savings in time has the same effect as increasing the rail carrier's car fleet. Thus, rail costs are reduced and part of the savings could benefit producers, although there is no guarantee that any of the savings will be received by the shippers. However, a study conducted on the Southern "Big John" case indicated that the entire reduction was transferred to the producer [2, p. 5–6].

After discussions by all interested parties, it appeared that the best opportunity for the isolated interior locations of Montana would be to concentrate upon eliminating some of the extra additional services provided by rail carriers that would help them to increase equipment utilization. As a result of this approach the Northern Lines Committee docketed a "no-frill" seasonal rate on grain from Eastern Montana points to Minneapolis-St. Paul and Duluth-Superior, subject to the following conditions:

1. No inspection, sampling, or hold privileges will be permitted under railroad tariff rules at origin, intermediate points, or at destination.
2. Forty-eight hours free time for loading and 48 hours free time for unloading. Petition to be filed with the Interstate Commerce Commission for relief in connection with these rates from order requiring seven days free time at Head-of-the-Lakes.
3. Specific place of delivery must be designated at time of billing. No orders for diversion or reconsignment will be accepted. No orders will be accepted to hold cars short of billed destination[4]

Another alternative explored was the use of multiple car shipments with minimum tonnages. As yet, discussions of this in Montana have not reached any agreement. During 1968 there were shipments of wheat in Montana on a trial trainload basis. A 50-hopper car trainload was shipped on the Great Northern Railroad from Wolf Point, Montana, to Portland, Oregon, and a 40-hopper car trainload was shipped on the Milwaukee Railroad from Great Falls to Pacific Coast ports.

The present proposed "no-frill" rate going east with the seasonal aspect is more encouraging. The seasonal rate was added for two reasons: (1) It is an attempt on the part of the carrier to level out seasonal movements, and (2) it is following the pricing practice of service based on demand.

Traditionally, there has been a much stronger demand for rail cars all along the system during the harvest season, which generally runs from July 1 to approximately November 30. As a result, the carrier is unable to furnish all the cars needed to fulfill the demand, and the price of service is higher than in the remainder of the year. The "no-frill" rate has not yet been initiated, and we have no way of knowing whether it will fulfill these two requirements.

If the "no-frill" seasonal rate is initiated, producers who have farm storage may want to store their grain during the season of high rates and attempt to move it to market during the season of lower rates—as much as five cents a hundred lower. Grain elevators may buy during the harvest season and fill their house at prices reflecting higher rates, then hold until the lower seasonal rate is implemented. To what extent these practices might be adopted will not be known until the proposal has been initiated and used by the shippers.

Role of agricultural economist

At this point, one might say that the agricultural economist who is working on a transportation problem, but has little or no formal training or background in transportation, will have only limited success in helping to ease the frustrations of shippers in an interior location. Any economist who is entering work in transportation would be well advised to consult early with management of different modes of transportation and with management of marketing firms and shippers to determine what the needs are and what approaches should be taken. Information needed for management decisions and the best method of approach to obtain this information can be determined through these consultations. It would seem that university extension and research economists can proceed to obtain relevant data by involving the people who are directly concerned. Keep them informed as progress is made in collecting data so that management decisions can be made as soon after publication as possible.

If we would have to isolate any one thing learned from this experience, it would be the very definite need for active involvement of all people who are interested. Keeping them constantly informed of progress is important to the success of such an effort. If the economist is going to fulfill the need and the demand for his services, he will want to perform the function of a coordinator as well as researcher. Adaptation of economics to the transport situation will help to provide information needed for decision making. Our efforts could be termed a *service*; if so, we are pleased that we have provided it to Montana.

During the last 18 months we have worked closely with the Montana Wheat Research and Marketing Committee. They have made a significant financial contribution, as well as assisting in the coordination and development stages of the project. Without their help and contribution, many doors that have opened grudingly would likely still remain closed.

We would urge economists to become involved in transportation problems. It is exciting, frustrating at times; but most of all, it provides some satisfaction that comes from being a part of the action.

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Discussion: Role of Transportation in Agricultural Marketing and Development*

JOHN O. GERALD

The papers presented today all seem to have a common theme: The actions of railroads in rate making are upsetting equilibriums under which agriculture has functioned for many years. Commodity production areas, inter-commodity relationships, locations of processing and storage facilities, sizes of firms—all of these elements are undergoing change, in part at least, as a consequence of crumbling rate structures.

In discussing changes in rail rate structures now under way and means for preventing them from adversely affecting agriculture, it is important to remember that we have no national railway system. Rather, we have some 70 or so Class I railroad systems and many other smaller systems. Traffic patterns in this country are such that most of the rail-truck-barge competition affects some of these independent rail systems to a much greater degree than other systems. Some of them will recover fixed costs into the forseeable future, but others cannot do so at present. If sunk costs of the railroads must be covered whether or not traffic moves, as Lauth and some transportation economists claim, we may soon have considerably fewer rail systems and miles of track. However, whether or not we have fewer miles of track really should depend upon the revenue earning potential of the track in relation to the revenue earning potential of the right-of-way in some alternative endeavor. Sunk costs are sunk. It is my belief that recognition of this economic truism by railroad management accounts for many of the actions we have observed in recent years.

Lauth discusses cost of service and value of service pricing principles. The cost of service principle is relatively straightforward. If competition from exempt trucks has reduced the traffic of unmanufactured agricultural commodities available to railroads, the Interstate Commerce Com-

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* The views presented here do not necessarily reflect the policies and opinions of ERS or the USDA.

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mission may allow rates that cover only out-of-pocket costs of the railroads to become effective. Otherwise, rates below fully-distributed costs may not be authorized. If out-of-pocket costs are good approximations of marginal costs of the railroads, efficient resource allocations are encouraged by this permissiveness of ICC.

Lauth's description of the value of service pricing principle should leave little doubt in your mind that substitution of the phrase "monopoly pricing" does little or no injustice to the description of the principle. ICC has exercised some control of the extremes which otherwise could occur under monopoly pricing by the railroads. Nonetheless, knowledge that value of service rate structures existed throughout the period of a near technological monopoly by railroads, roughly 1860-1950, provides an understanding as to why rate structures are now crumbling.

Lauth ends with the conclusion that "the location of farming is fixed by nature and cannot, and should not, be restricted by the absence of truck or barge competition." He fails to hypothesize that internal subsidizations by our railroad industry helped nature in fixing present locations of agriculture and to give us the prescription by which location is to be maintained.

Agricultural rail rate structures, as noted by Lauth and Nicholls, held stable for decades, despite conflicts of interest among subsets of the railroad using public, among subsets of the railroad owning public, and between these two publics. As long as railroads had a near technological monopoly, legal external rate structures could be maintained. Flows of funds internal to the railroad industry through divisions of joint rates, per diem rentals, etc., permitted some balancing of the equities of specific subsets of the railroad owning public, with no change in external rate structure goals. Even so, the long-term stability of external rate structures is quite amazing in many respects.

In my opinion, internal flows of funds between our many independently owned railroad systems will continue to be very carefully scrutinized by railroad managers. These managers owe a responsibility to their investors to recover sunk costs. The level of aggregate railroad earnings is such at present that permitting new flows to arise, and even letting traditional flows to continue unchallenged by management, is criminal behavior from the viewpoint of investors. If Lauth has internal subsidization in mind as his prescription for maintaining the location of farming, he also must have in mind complete regulation of transportation, including private carriage, or alternatively, public guarantees to railroad and regulated truck owners that their investments will be covered. I have found no estimates of benefits and costs of either of these possibilities in relation to the benefits and costs of agricultural relocation to optimize use of transport services.

Nicholls discusses the role of transportation in regional development in conventional terms and I have nothing significant to add to his discussion. However, at several places he appears to display some concern that the structure of agricultural shipping and receiving firms may be modified by rate and service actions taken or under consideration by the railroads. Wisely, in my opinion, he fails to judge these actions as good or bad. As I mentioned above, value of service rate structures crumble with the onslaught of competing transport technologies, and many agricultural shippers were large enough already to adopt or threaten to adopt alternatives.

In discussing some of the competitive forces causing railroads to adjust their rates and services for agriculture, Nicholls cites the agricultural exemption as one factor. Miklius [2] failed to find unambiguous evidence that the agricultural exemption has really had an adverse effect upon the traffic available to railroads. More importantly, or so it seems to me, the agricultural exemption gave a truck transportation alternative to small-scale agricultural shippers and receivers at costs similar to those which large-scale shippers and receivers were able to achieve through contract or private trucking. The shift of traffic from rail to truck has likely been as great or greater for manufactured as for unmanufactured agricultural commodities, and much of this traffic moves by private or contract trucks rather than by regulated trucks [3].

Nicholls states that the actions by railroads to reduce coarse grain rates without similar reductions on grain products created an incentive for grain processors to relocate from grain producing to grain consuming areas. There is no question but that such incentive exists, but did it not exist prior to the actions of the railroads? Truck and barge movements of raw grain into the Southeast have existed a long time. Again, the railroad action must be characterized as an intermodal competitive move necessitated by the nearly complete attrition of the former rail monopoly in transport.

Finally, Nicholls states that ownership by the volume shippers of a substantial portion of the limited supply of railcars could adversely affect availability of cars to small shippers and receivers. I agree, but elsewhere I have hypothesized that the change in the per diem code of the Association of American Railroads in 1964 has removed much if not all of the disincentive prevailing prior to 1964 for railroad ownership of specialized, high cost cars to be used in interchange service [1]. Pat Boles of ERS and I are now engaged in research to determine if the 1964 change in the per diem code has resulted in any perceptible change of specialized car ownership trends existing prior to 1964. We hope to have reportable results in the near future.

Rust is quite correct in stating that Montana wheat producers can exercise much control over the seasonality of their demand for transport. The flexibility provided for them and for shippers by vast grain storage facilities may be the principal factor preventing freight car shortages of recent years from being catastrophic. The price risks borne by producers and shippers, nonetheless, are sizable. Unless means for shifting these risks through futures trading or forward sales can be exercised, producers and shippers likely will have seasonality in their transport demand.

The rate situation that Rust describes for Montana is in accord with what I would expect to find. Rail costs vary little with distance of shipment, while truck costs are composed almost entirely of direct line-haul costs. Thus, railroads serving long-haul landlocked areas are the last ones to encounter direct intermodal competition. In the absence of clear evidence that indirect effects will undermine their traffic base, the decisions of rail managers to continue to charge rates that will recover sunk costs cannot be condemned as irresponsible.

To conclude, it seems quite clear to me that advances in transportation possibilities of recent decades have had very significant income-transfer effects within our agribusiness economy. It is less clear to me that there have been equivalent resource-reallocation effects in our land-extensive agricultural economy. It is not at all clear to me that rate decisions of the railroads alone have had significant effects on either income transfers or resource reallocations within our agribusiness economy. The decisions have had effects on both income and resource allocations within our transport industry. Taken in this frame of reference, the significant contributions we as agricultural economists can make in the transport decisions of the future may be in initial stages of planning new transport systems. The rate decisions following the development of new possibilities are important, but the effects of the rate decisions may be primarily internal to the transport sector.

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CONGLOMERATE TRENDS IN BUSINESS STRUCTURE

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Factors Underlying Business Interest in Conglomerate Mergers

ODIN WILHELMY, JR.

ANYONE who has been even reasonably alert to trends in American business in recent years is well aware that merger has become a way of life. There were an estimated 4,462 mergers in 1968, and the number in 1969 is expected to rise to 5,400 [2]. Over the past five years or so, a growing number of such mergers have been instigated by firms that have come to be known as "conglomerates."

Since different people have different ideas on what a conglomerate is, let me define the word as I will be using it in this paper. I am not talking about the more conventional forms of merger that have been commonplace for a long time—horizontal integration (such as occurs when one fertilizer company acquires another fertilizer company) or vertical integration (such as the purchase of a broiler operation by a feed manufacturer). Neither am I talking about diversification into related product areas (a soap manufacturer buying a bleach producer) nor into different geographic areas in the same product line. Rather, I will be talking primarily about mergers in which one company takes over or combines with another whose product line is completely dissimilar, such as an electronics firm acquiring a meat packer or a telephone company buying a vending machine company.

Conglomerates, even by the latter definition, have been with us for a long time. One need only cite such giants as General Electric, Ford, and Westinghouse to confirm this. However, these companies got that way long before the recent wave of acquisitions that have led to such well-known enterprises as Ling-Temco-Vought, Textron, Gulf and Western, and Litton, to name only a few. The fact that a number of major U. S. food and agricultural companies—Armour, Wilson, John Morrell, United Fruit, Allis-Chalmers, Canteen Corporation, Sunshine Biscuit, etc.—have been involved in such acquisitions (actual or threatened) makes this particular session of more than passing interest to agricultural and food economists.

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Reasons for Conglomerate Mergers

The reasons for merger of a conventional sort are well established and accepted and generally rational in terms of both economic principles and good business practice. The overall reason for such combining of business enterprises is the conviction that bigger companies can operate more efficiently and more profitably and better serve the consumer than can small companies. The individual reasons underlying a particular merger will vary, but they all contribute in one way or another to this broad objective.

Diversification of a product line or into a different geographic area is one common reason for merger. When White Motor acquired the Oliver Corporation some years back, White broadened its product line—powered vehicles—into a new, but related, area. When Borden acquired other dairy companies, it broadened its market area.

Increased operating efficiency certainly is another good reason for merger. This increase may be effected at any of several levels. At the administrative level, it may permit the spreading of overhead costs over a broader production or marketing base through, for example, the combination of duplicate research, advertising, or public relations functions into single operations. At the production level, there may well be economies of scale achievable through merger that could not otherwise be obtained. Similarly, at the marketing level, a strong existing sales force in the field may well be able to take on the selling of additional, related products with relatively little increase in personnel or marketing costs. A good example would be the merger, many years ago, of the McGraw and Hill publishing enterprises.

A third specific reason that can be cited is the desire to apply particular know-how or capabilities developed in one industry to the business of another industry. For example, a strong research competence in a chemical company might well be a catalyst to significant growth in a steel company, if the former is brought into the fold and can contribute the benefit of its research strength. By the same token, established competence in consumer marketing can be the spring-board for a company dealing in one consumer product to move into other such products. Undoubtedly this was a major factor in the thinking of R. J. Reynolds and American Tobacco when they moved, by acquisition, into the food and beverage fields earlier in this decade.

These, then, are some of the conventional reasons—among many that could be cited—for merger in the normal sense. Let's consider now what are the reasons for conglomerate merger—bringing together in the same organization business firms that are completely unrelated to one another. Here the picture gets somewhat fuzzier.

Certainly there are a number of cogent reasons for conglomeration in the present-day American business economy. These have been highlighted both by executives of such firms in their public statements and by analysts of conglomerates who have been trying to figure them out. One obvious reason is that existing antitrust laws preclude further growth for many companies through conventional merger procedures. Until such time as a new set of laws is created to control conglomerates, this growth route represents a mechanism for expansion that doesn't put the company concerned in jeopardy of an antitrust suit.

Another significant basis for conglomeration is to spread the risks of business declines or drops in sales and profits that can occur in any product or industry at a given time. If you assemble a group of companies that are unlikely to be subject to cyclical ups and downs at the same point in time, you can minimize the effects of such cycles on the firm as a whole. As James Ling of Ling-Temco-Vought expressed it in a talk last year [5], "I made a vow that never again would any company for which I was responsible be dependent upon any one market, any one product, or any one technology." This, of course, is simply diversification—but to greater lengths than companies have tended to go in the past.

A third reason cited by conglomerates, as they move toward acquisition of a given firm, is that the target company, while well-heeled and solid as a rock, is being run by people who have become lethargic, unimaginative, and outmoded. The conglomerate promises to infuse it with new ideas, new blood, and up-to-date managerial techniques. Underlying this factor is one that is, perhaps, more basic. I refer to the intense personal ambitions of many business leaders. Building a conglomerate business empire represents a latter-day outlet for the same kinds of psychological driving forces that motivated military and political leaders like Alexander and Napoleon.

There is another set of reasons for conglomeration that arise from the current state of the U. S. economy—a state that has resulted from the recent steady growth of that economy, the accompanying inflation, the increasing complexity of business management, and the sophisticated new tools that have become available for coping with that complexity. In a paper at the NCR-20 Seminar in Kansas City this past April [3], A. C. Hoffman of Kraft Foods noted four of these factors encouraging the formation of today's large-scale enterprises and discussed each in some detail. They include (1) increased capital requirements, (2) capital formation, (3) risk taking, and (4) business management. Milton Leontiades, in an excellent paper in the *Financial Analysts Journal* the following month [4], carried the discussion a step further and noted three ingredients important in achieving superior management—a stong management information system, effective economic forecasting (for various pieces of the conglomerate), and dynamic long-range forecasting.

Since the brevity of this paper precludes any discussion of the four factors or the three tools that help ensure the quality of the business management factor, I will simply concur that these are increasingly essential to success in today's high-pressure business world. I also will agree that these are functions that may be performed more effectively in a conglomerate structure with its larger and broader base of operations—but the proof of the pudding here lies with the people running the operation.

In passing, I should note that conglomerates are *not* intended to provide centralized control of production and marketing activities of the component companies. There is ample evidence to date that these functions are being handled on a decentralized basis.

Evaluating the Results of Conglomeration

Given these reasons for conglomeration (in whatever mix they may occur in a given merger), one can well ask next: To what extent are these objectives being fulfilled, or likely to be fulfilled, in actual performance? This is difficult to judge at the present time. In its present form, the conglomerate idea is still relatively new, and for many such firms there simply hasn't been time to see how it will turn out. Compounding the problem is the fact that some of the financial devices used tend to obscure the true results of a given merger. (It is possible to generate an apparently improved profit picture simply by the manner in which the acquisition is consummated.)

In such a situation, perhaps all that one can do is to raise some pertinent questions, with the hope that answers will be forthcoming before too long. I'd like to do this—with emphasis on some groups of people who certainly will feel the effects of conglomeration one way or another, but who may have little or no influence on how the "deal" is accomplished or on what happens afterwards.

One such group of people are the managements of acquired companies, who may or may not have much to say in the matter. I am aware of one food company taken over recently where there was enough dissatisfaction at the middle echelon with the indecision prevailing at the top that a shake-up in top management probably would be welcomed. On the other hand, there have been instances in which a sizable number of top executives in the acquired company have been pushed out without apparent reason.

What about the stockholders who may have reaped the rewards of rising prices for their shares in the early days of the new firm but who now may be licking their wounds and wondering when their clever investment is going to stop losing value? You can bet that investors are going to be watching the conglomerates closely from here on, trying to sort out the good from the bad.

How about the customers of the component companies and the general public? Will they really benefit from the claimed greater efficiencies of the conglomerate companies, or will the latter find themselves unable to deliver? Finally, since I am in the research business, I wonder what the effects of conglomeration will be on the research activities and competence of the acquired firms. Certainly there will be efforts in some cases to upgrade the productivity of research staffs or to expand their sphere of operations to benefit all parts of the conglomerate. In others, however, the net result may be the opposite, and research personnel may look elsewhere for a job where the pressures are less intense.

Future Prospects

One may assume with reasonable certainty that merger in some form will continue as a way of life in American business. Whether those mergers will be increasingly in the form of conglomerates remains to be seen. One may also assume that food and agribusiness companies will be a part of this continuing merger trend—conglomerate and otherwise. Ron Aines in a recent paper [1] cited the chain of retail farm service centers being established by National Farm Stores, Inc., and Litton Industries in various Iowa towns—centers that will provide in a single location a wide variety of products and services for farmers.

While I can understand and appreciate the many reasons for the recent advent of conglomerates, I am still old-fashioned enough that I find more merit in the types of mergers that have prevailed over the years. To me, it makes good business sense for a fertilizer company to move into pesticides and then into application equipment and then into grain handling. It also makes sense for a feed manufacturer to get into broiler production or feedlot operation. I also see merit in a tobacco firm with its consumer marketing skills getting into the food business and applying those same skills there. I can even sympathize with some of the farm co-ops considering going into food retailing on a large scale. All of these more or less "conventional" methods of business expansion strike a more responsive chord in me than conglomeration among totally unrelated businesses. But perhaps I, along with a lot of other people in this country, are going to have to relinquish such outmoded ideas or be swept aside by the conglomerate movement.

In closing, I'd like to mention one problem area in which conglomeration may be the answer, namely, the upgrading of the food and agricultural situation in developing countries. For years now, we have heard and read of the multifaceted nature of this problem—the need to provide fertilizer, seed, irrigation, improved roads, better storage facilities, modern food-processing plants, refrigeration, adequate marketing arrangements, a market news service, credit, and so on. Perhaps this is one place where a conglomerate, either actual or in effect, would be the best way to solve the problem.

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Firm Conglomeration as a Market Structure Variable

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BUSINESS conglomeration is not new. There have long been examples of multimarket and multiproduct business enterprises, the distinguishing features of the conglomerate firm. What is new, and what makes business conglomeration a timely public policy issue, is the profusion and enormous size of many contemporary conglomerate enterprises. Today most huge industrial enterprises straddle numerous industries, often doing only a small share of their total business in any one industry. Hence, conglomerate enterprises are no longer the exception, but the rule, in many contemporary industrial markets.

This development is of no lesser significance than was the replacement of many highly fragmented, small business industries by oligopolistic, big business enterprises beginning with the great merger movement around 1900. Economists responded to the new industrial structure emerging from that era by developing the theory of monopolistic or imperfect competition, and, ultimately, the body of price theory now encompassed by industrial organization theory.

The multimarket character of the modern conglomerate enterprise raises a number of important questions regarding the relevance of contemporary industrial organization theory and empirical research. The conglomerate enterprise may enjoy economic power that differs from the traditional market-oriented concept of market power. According to traditional theory, market power is derived from the characteristics of a particular market, especially the level of seller concentration, the extent of product differentiation, and the condition of entry. In this theory, market power is shared—e.g., in the form of higher prices and profits—by the sellers in the market at the expense of buyers. Conglomerate-derived power, on the other hand, differs from traditional market power in important ways. It depends upon intrafirm structure—particularly upon a dissimilarity of intrafirm structure among the companies that may be rivals in a particular market—rather than solely upon the structure of that particular market.

The most immediate effect of conglomerate power is the advantage it gives over rivals rather than over buyers. But ultimately it can work to the disadvantage of buyers because it may weaken or repress rivals, in-

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duce defense reactions by them, and discourage entry by new firms. Thus, conglomerate power can restructure particular markets by placing new restraints on the behavior of existing firms, by changing market shares, or by raising entry barriers.

Today I shall discuss briefly three market conduct options unique to conglomerate firms and not adequately explained by traditional industrial organization theory: business reciprocity, cross subsidization, and conglomerate interdependence and forbearance.

Business Reciprocity

Business reciprocity, simply defined, is the act of taking your business to those who bring their business to you—many would say that it is no more than doing business with one's business friend. But this misses the point. Buying and selling decisions guided by industrial "friendship" are a symptom of market power when the firm uses its market position in one market to expand its sales in another.

Reciprocity permits the seller to make a sale that it could not otherwise make or could make only at greater costs. Thus, reciprocity flows from "imperfectly competitive" or "oligopolistic" markets. In highly competitive markets, there is no need to engage in reciprocity or other business strategies to expand sales. But as markets become concentrated, individual firms recognize their interdependence and refrain from price rivalry, with the result that prices are maintained above marginal costs. Since open price competition in these industries tends to "spoil" the entire market, prices are "administered" and nonprice competition becomes the order of the day. In this market setting the oligopolist thus seeks the most attractive —and from his standpoint, the most economical—form of nonprice competition. He has a variety of forms from which to choose, including product differentiation, product development and innovation, advertising and promotion, tying arrangements, and reciprocity. Which of these forms he ultimately selects depends upon certain legal and economic considerations.

But before an oligopolist may include reciprocity among his alternative sales strategies, certain necessary conditions must be met. Most importantly, an enterprise must purchase goods and services from companies that are also its potential customers.

The volume of sales that may be influenced by reciprocal trading depends on the number, volume, and types of products purchased and sold. A single-line producer is bound to have fewer opportunities to use the practice. Similarly, producers selling only consumer goods are unlikely users because their suppliers of raw material and components absorb only minimal amounts of consumer goods.

The firms that have the greatest opportunities to engage in successful reciprocity are those that buy and sell a large number and volume of industrial products. This, of course, describes many of the large diversified industrial corporations of today.

Reciprocity introduces an alien factor in the competitive process, one superimposed on the normal elements governing market transactions in which goods are bought and sold on the basis of price, quality, and service. In a purely competitive market, the individual firm has no control over supply-and-demand conditions and in these markets reciprocity would have a negligible influence on industrial performance. Reciprocity becomes a serous anticompetitive influence when it bypasses and distorts the competitive process. In this respect it resembles other nonprice forms of competition, such as promotion designed to differentiate products and shield them from price competition. But unlike promotional efforts that can increase the velocity of trade, and sometimes the aggregate sales of particular products (as distinguished from the sales of a single firm), reciprocity merely rechannels trade in favor of firms able to exert reciprocal market power. In oligopolistic markets where price, quality, and service tend to become stabilized, reciprocity can become the decisive factor in shaping the market. If carried to its ultimate, the practice would result in closed-circuit markets that would exclude medium or small factors. Thus, oligopoly would be magnified in a sort of circular integration fashion by which purchases of the leading firms would be tied to sales, foreclosing the opportunities of firms without substantial conglomerate power.

In sum, reciprocal selling may (1) distort the exchange process, thereby stimulating more rigid price structures and misallocation of resources, (2) increase market concentration, thereby endangering long-run industrial performance, and (3) raise barriers to entry, thereby reducing the salutary effects of potential competition. The net effect of extensive reciprocity may be to centralize manufacturing resources and decision-making in the hands of a relatively few firms.

Although I shall not discuss here the empirical evidence of the extent and consequences of reciprocal selling in the economy, recent antitrust cases and investigations reveal that its use has grown in importance as firms have become more conglomerated.

Cross Subsidization

Cross subsidization is the ability to offset losses in one profit center by means of income generated in other profit centers. The ability to practice such subsidization depends upon the characteristics of a firm's diversification compared with those of its competitors and upon the structure of the various markets in which it operates. If a large multimarket firm operated only in a series of competitive markets, it would earn no "excess" profits that could be used to subsidize expansion in other markets. On the other hand, when a substantial part of a large conglomerate firm's operations is lodged in highly concentrated industries, it is likely to earn profits above competitive levels. The greater its "excess" profits, the greater its ability to subsidize with internally generated profits its strategies to enter, condition, expand, or defend particular markets.

Some economists argue that large absolute size, quite apart from market power in particular markets, confers market power on a firm. Other economists reason that unless the conglomerate firm possesses market power in some markets, it cannot have an advantage over its smaller, less diversified rivals. Economists generally agree, however, that if a multimarket firm possesses market power in some markets, it may become a vehicle for the achievement of market power elsewhere. Quite clearly, any advantage inherent in large size and conglomeration will be magnified when the firm possesses market power in some of its operations. For, if a large multimarket firm occupies substantial market positions in some of its product or geographic markets, it may use the profits derived there to subsidize its attainment of market power elsewhere.

Firms practicing cross subsidization may enhance their profit opportunities by restructuring a market or by modifying conduct within it. The affected market can be restructured by increasing its level of concentration and/or its domination by conglomerate firms, with a concomitant raising of entry barriers. Conduct can be modified, for instance, by introducing new or more intensive use of marketing techniques, e.g., advertising and promotional activities, as well as by price cutting. The nature of the barriers to entry can be changed by conduct that gives new emphasis to marketing expenditures or by conduct that intimidates potential entrants by the ability to concentrate the resources of the diversified firm in any particular market. A diversified firm that uses its conglomerate power to restructure an individual market can also use such power to defend the restructured market. The threat resulting from the potential use of such power can transform this defensive readiness into a barrier to entry. Such conduct tends to limit potential entrants to other conglomerate firms, which, when not deterred by conglomerate mutual interdependence and forbearance (as discussed below), may further restructure the market as it becomes increasingly dominated by conglomerate firms.

The ability to pursue tactics financed by cross subsidization does not necessarily injure competition, nor do those engaging in the practice necessarily do so with predatory intent. The effects depend upon the structure of the affected market and the nature of the competitors, actual and potential, operating in the market. Indeed, there are market situations where the ability to cross subsidize is an imperative of entry. This is true in industries with high "start up" costs or "break in" costs. The latter situation may obtain when existing firms enjoy a product differentiation advantage or conglomerate power. If entry into a market were free, a firm would have no incentive to restructure the market through cross subsidization tactics. For even if a monopoly were attained, it would have gained no permanent surcease from competition because new entrants would flood the market should the monopolist charge above competitive prices. But in modern industrial markets, entry is seldom so free that potential entry alone forces oligopolists to price at competitive levels. Moreover, the mere presence of firms with conglomerate power ready and able to rebut a price-cutting entrant may itself create a formidable barrier to entry. As Robert C. Brooks has observed, "... knowledge that an existing firm is ready to engage in predation, and that such predation would inflict losses on the victim, would itself serve as a barrier to entry."

I shall not here attempt to demonstrate the ways in which cross subsidization is influencing contemporary industrial structure conduct and performance. But there is no doubt that many firms possess the power to engage in this practice, and that this power is frequently exercised—for good or ill.

Conglomerate Interdependence and Forbearance

Oligopoly theory, a la Chamberlin, teaches that when sellers are few they tend to behave interdependently in making their price, output, and other market decisions. As a result, in highly concentrated markets sellers behave more like monopolists than competitors.

This accepted theory of oligopoly explains the behavior of firms in a single market where their discretion in pricing is constrained solely by certain structural characteristics of that market. Useful though this theory is in explaining many aspects of industrial behavior, it is inadequate in explaining certain important behavioral characteristics found in contemporary markets. The multimarket characteristics of firms may result in conglomerate mutual interdependence and forbearance among actual and potential competitors—an interfirm relationship that differs from traditionally viewed ologopolistic interdependence.

Conglomerate interdependence and forbearance can arise because (1) the same or related decision makers have simultaneous access to both firms, or (2) the firms share contact points in input or output markets that create a mutual awareness of common interests. Interlocking directorates, intercorporate stockholding, joint ventures, and a whole spectrum of institutional arrangements encouraging the creation of a community of interests represent the first set of factors that facilitate coordinate relationships among firms. Firm structures, i.e., their size, diversification, and positions in various markets, constitute the second set of factors that create a commonness of interest. Conglomeration, by increasing both size and diversification, increases the number of contact points shared with competitors, suppliers, and customers, thereby increasing the mutual awareness of common interests among firms that share the points of contact.

The simplest form of conglomerate interdependence probably involves pricing decisions. Firms that meet as competitors in many markets are likely to regard one another with greater deference than if their decisions were constrained solely by what happened in a particular market. The resulting mutual forbearance in making pricing decisions results because conglomerate rivals are less likely to push their advantage in one market lest their conglomerate rivals retaliate in others.

Although conglomerate mutual interdependence is most obviously manifested in price decisions, it may take more subtle forms. Records in various antitrust proceedings provide rich evidence that, when corporations become large and conglomerated, they tend to accord special treatment to other large national and even international corporations.

Again, time does not permit documentation of the extent and consequences of shared contact points among contemporary conglomerate enterprises. But I am confident that interdependence and forbearance flowing from such shared contact points leads to the consideration, proposal, and realization of acts that affect market shares, entry, and pricing practices. Such conglomerate interdependence has more global implications for industrial behavior than the traditional concept of oligopolistic interdependence.

Conclusion

Quite clearly, I have been discussing matters that differ from traditional oligopoly theory predicated on single-product, single-market firms. What I am suggesting today, therefore, is that our changing industrial environment demands a broadening of the theoretical framework used in analyzing much of our contemporary industrial scene. Simply put, probing many real world problems calls for according firm conglomeration independent status as a market structure variable. Only by doing so can economic analysis make a relevant contribution to many of our most pressing public policy issues.

Perhaps I have disappointed those who had expected me to address myself to the topic originally assigned me by your program chairman, namely, the public policy issues involved in the current conglomerate merger movement. That is a topic dear to my heart and to which I shall shortly address myself elsewhere. What I am urging today is an extension of the argument that Bob Clodius and I made just before I came to Washington eight years ago. At that time we urged that agricultural economists should make greater use of market structure analysis as an orientation in their research [1]. The rich body of empirical industrial organization research done since then argues persuasively for a continued use of

Conglomerates: Economic Conduct and Performance

Albert G. Madsen and Richard G. Walsh

> Perhaps all that is not performance is preparation, or performance that shall be.
> —Ralph Waldo Emerson

THE words which have been used to specify this discussion—conglomerates, economic conduct, and performance—no doubt evoke in each of our minds different meanings, different values, and a different set of facts as to their relationship. The purpose of this discussion is to explore what common ground actually exists and what real differences we have. What are the alternative meanings of each of these words? What is the state of knowledge with regard to the effects of conglomerates on economic conduct and performance?

Significance of Our Terms

By reference to a conglomerate, rather than to a diversified, multi-market or multi-product firm, the subject is already loaded. Managers of diversified firms often seek to avoid use of the word, believing that it denotes a lack of inner logic. In this view, a true conglomerate produces products or services of several industries that are related only with respect to managerial and financial functions or economies, but not with respect to product development, purchasing, production, or marketing. We are advised to use the less emotive terms, such as diversified, multi-market, or multi-product, for firms related in the latter ways. By this definition, only eight of the 200 largest U. S. corporations qualify as conglomerates. Notably absent from the list are such multi-product giants as General Motors and General Foods.

Product relationships are, of course, a matter of degree, and opinions may differ concerning whether those within a diversified firm are significant. However, to most economists the term conglomerate has gained too wide a usage to be nearly defined away. We see the term as encompassing most large corporations as special kinds of firms that "operate in two or more separate product and/or geographic markets" [18, p. 3]. This reflects the value we place on the economic theory of the firm. By this definition, virtually all of the 200 largest corporations are conglomerates, as are the 50 largest food manufacturers and the large retail food chains that operate across many product and geographic markets.[1]

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[1] Mueller suggests that several large retail food chains possess the basic characteristics of the conglomerate enterprise. They are much larger than their competitors,

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The most important, and widely held element in the definition of a conglomerate reflects the fact that its conduct is not subject entirely to the competitive discipline of any one market. However, economists differ as to the nature and extent of the advantage this confers. Some reason that, unless the conglomerate firm possesses market power in some market, it cannot have any special advantage over its smaller, less diversified rivals [20, pp. 19, 44, 46, and 202–210]. Most economists would agree that if a multi-market firm does possess market power in some markets, such power may become a vehicle to achieve market power elsewhere.[2] It may use the excess profits derived in such markets to subsidize its expansion elsewhere.

Market conduct has been emphasized by those most critical of conglomerates [6, pp. 331–360]. Of special concern are the practices of: (1) deep pocket subsidization or promotion of operations in one market out of profits from another; (2) reciprocity or purchasing decisions designed to increase sales; (3) full-line or tie-in selling of multi-products; and (4) forebearance as firms meet in several different markets. Critics not restrained by long conditioning to an economic theory that values a market economy above all else still find ample imperfections in the behavior of conglomerates with respect to stock promotions. Indeed, some observers see economic conduct of conglomerates with respect to the stock market, financial, and accounting procedures as far more important than product market conduct. It should be readily apparent that the scope of our treatment of conglomerate behavior is limited by the meaning we assign to the term.[3]

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operate across a large number of separate economic markets, occupy much larger positions in some market than others, and the largest retailers meet one another with increasing frequency in their respective markets [17, p. 1865].

[2] This is where our concern with conglomerate or overall concentration is related to industrial or market concentration. The 50 largest food conglomerates, with nearly 50 percent of the assets in food manufacturing, held over two-thirds of the top four firm positions in the 40 food industries. They are most important in the most concentrated food industries. This is significant because profit rates are much higher in the highly concentrated food manufacturing industries than in the lower moderately concentrated ones. Food manufacturing firms operating in industries with concentration ratios exceeding 60 percent enjoyed average net profit about 60 percent above those in industries with four-firm concentration ratios between 40 and 50 percent, and over 100 percent greater than those in industries with concentration ratios below 40 percent [20, p. 3].

[3] For more than three-quarters of a century, Congress has cast a critical eye on large conglomerate corporations with respect to the nonmarket uses of power. Their large size has been associated with undue political strength, legal harrassment, and public relations (subsidizing studies and buying their own reputations). Other observers less critical of conglomerate market behavior often emphasize those types of economic conduct that are internal to the firm. In this view, most practices of conglomerates are just good business management. Falling into this category are efforts to minimize the costs of new product introduction, risk, taxation, research, management overhead, finance, etc.

The economic performance of conglomerates refers to the results of their economic behavior. Society is concerned with how conglomerates perform in terms of efficiency, profit levels, selling costs, product quality and variety, and progressiveness. These variables are drawn from partial equilibrium analysis. There are more general criteria such as the contribution of conglomerates to economic stability and growth. Some have questioned their contribution to many of the most pressing problems of the day—water and air pollution, job retraining, urban and rural poverty, preservation of our natural resources, promotion of basic research, to name a few. Thus, the significance we assign to the performance of conglomerates is related to our choice of variables to be included in the analysis. All students of the subject are not in complete agreement.

Economic Conduct of Conglomerates

The economic historians among us will find in the archives considerable documentation of noncompetitive behavior of conglomerate firms. For example, the large meat packing conglomerates of the late 1800's and early 1900's engaged in collusive arrangements with regard to fixing beef prices, division of territory, division of public contracts, and compulsion of retailers to buy beef from certain packers [21, p. 6]. Many other conglomerates of this period behaved in ways equally as disruptive to the competitive system.

The fact that meat packing companies were engaged in such diversified businesses as operating service companies, developing land, operating stockyards, canning, banking, publishing, etc. [8, pp. 45–47], gave them considerable market power, clearly recognized and respected by one another, and led to unified actions. However, an important factor that led to considerable forebearance in competition among the large packers, as early as 1917-18, was their joint ownership of 108 companies [21, p. 6]. Pressures for competitive forebearance today arise more from reciprocal trading, without the type of overt collusion that was evident among early conglomerates. As early as 1930, important reasons for the government arguing against relaxing the Packers' Consent Decree was the willingness of the "petitioners" to employ collusive and coercive tactics in competition and to use their dominant positions in certain lines to promote their interest in others [2, p. 101]. Some fear that similar behavior may arise from present day conglomerates.

The methods by which conglomerates have promoted good will and encouraged the public to purchase their stock during the recent merger movements are reminiscent of those that led to serious problems in the past. The practice of manipulating reported earnings (increase the earnings per share) without disturbing or increasing the production capacity or the efficiency of the company warrants concern. The firms initiating the mergers have been able to achieve this by paying for the acquired firm's stock with their higher priced stock. The result is a smaller number of shares in the hands of all stockholders in the combined company. Even though the total earnings of the conglomerate may be identical with the total earnings of the two companies before the merger, the earnings per share would reflect a growth. These earnings have then been publicized to attract stock investors who have bid up the price of conglomerates' stock [9, p. 81]. The economy has not become any richer. A second method used to "puff" the earnings statements of aggressor conglomerates is to use the "pooling of interest" method of accounting and then to sell some of the assets acquired when new firms are taken over [9, p. 180].

Reciprocal trading has long played an important part in doing business in our capitalistic environment. However, there is increasing antipathy toward the practice under the present trend in business size and conglomerate organization. An effective way to gain the friendship and goodwill of a possible customer is to buy some of his products. The popularity of such arrangements is the fact that industries dominated by big companies have purchased from one another for years. McCreary & Guzzardi estimated that in 1965 about 60 percent of the companies on Fortune's list of the 500 largest industrialists employed "trade relations men" whose functions were in part to conduct reciprocal dealings [15, p. 81].

Although there are nearly infinite opportunities for reciprocal trading among large conglomerate firms, this is more clearly demonstrated by observing possible buying and selling arrangements between two such firms, for example, Olin Mathieson with 10 product divisions and Textron with 37 divisions [10, p. 170].[4] We do not know that these specific conglomerates trade in reciprocal fashion, but the conglomerate structure of these companies does seem to provide opportunity for close working relationships, and this example demonstrates the extent to which forebearance may be encouraged. There is the possibility of vigorous competition between such firms in many markets but can this competition be effective where significant reciprocal trade relations exist?

We have discussed only one aspect of the problem—that of competition between large conglomerates. A more damaging consequence of reciprocity may be the formidable barriers to entry for small or less diversified firms. In selecting suppliers, the standard may become "which supplier is one of my best customers," rather than "what firm can provide the specific item at the lowest cost, yet meet required service and product standards."

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[4] There appears to be the possibility that all 10 divisions of the Olin Mathieson Company could utilize the products of one or more Textron division. On the other hand, without benefit of company records, it seems that at least 24 Textron divisions could use products of Olin Mathieson and that 12 divisions of Textron make products which could compete with the products of Olin Mathieson.

An example of how close trade relationships between conglomerates have dampened or even killed off competitive actions is documented in a report of the National Commission on Food Marketing [19, p. 413]. Consolidated Foods, a food manufacturer, and retailer, cut prices in its seven supermarkets in Chicago. National Tea Company, a large food retailer reacted by refraining from buying Consolidated's products for a week. Consolidated quickly returned to regular prices and somewhat later sold its Chicago retail food stores.

Another practice of the large conglomerates is to use their "long purse" in disciplining competitors. There is evidence that firms possessing such power have utilized it. For example, in 1954-55 Safeway engaged in a price war in the Dallas and El Paso market areas to combat trading stamps. Since Safeway is a multi-market firm and handles multi products, it was able to subsidize deep price cuts in these more competitive markets with above normal profits from less competitive markets. Government counsel Margaret Brass, in the summation of the case, stated that Safeway, by its below cost selling operations, had sustained a 15-month loss of about $4 million in the two divisions together [26 pp. 73–74]. The conclusion of the FTC was that Safeway was quite willing and able to utilize competitive tactics that resulted in substantial losses in one of its major divisions over a significant period of time, without suffering a serious adverse effect on its overall profit performance [7, pp. 84–90].

Economic Performance of Conglomerates

Galbraith argues that large conglomerates may contribute more to the growth of the economy because of their superior managerial, technological, and financial strength. According to this view, most of the growth of large conglomerates has been internal, through the construction of new plants and equipment and market expansion. Indeed, the primary reason the share of total manufacturing assets held by the top of 200 corporations grew from 48.1 to 54.2 percent, 1948 to 1960, is due to this superior economic behavior. While this view may have squared fairly well with the facts during the early postwar years, it appears to have been wide of the mark during the decade of the sixties. Merger activity by the 200 largest corporations accelerated during the 1960's. Between 1960 and 1967, their share of total manufacturing assets grew from 54.2 to 58.7 percent. But after the acquired assets are subracted, their share for 1967 was 54.4 percent, essentially the same as in 1960 [11, p. 79]. And this is probably a minimum estimate of the importance of mergers to their growth since it does not take into account the postmerger growth of acquired assets. Without mergers, their growth rate would have fallen below that of smaller firms. Thus, during the past decade, the largest 200 conglomerates appear to have had a negative effect on the economic growth of the economy. For mergers by themselves have added no output to the economy, no new employment, nor new plant construction.

Conglomerates may be especially able to take an inefficiently managed division and turn it around. Potential social gains from improved production efficiency may be substantial. This is what Leibenstein [14] has termed X-efficiency and illustrated with a large number of worldwide case studies showing realized efficiency gains frequently above 25 percent of unit costs.[5] The empirical evidence, while far from exhaustive, suggests that many firms have not been operating on their production frontier and would respond to improvements in general management, plant layout, personnel, production procedures, selling organizations, and budgeting and accounting systems.[6]

Large conglomerate corporations have had higher profits in the past than all U.S. manufacturing firms. Weston analyzed the financial performance of 58 multi-industry firms over the nine-year period, 1958 to 1966.[7] Earnings per share grew 10 percent a year versus 6.7 percent for all firms in Standard and Poor's stock index. Stock prices at each year's high rose 10.5 percent a year against 5.4 percent for the Dow-Jones industrial average. In 1967, conglomerates had average profits of 12.6 percent of net worth compared with 11.9 percent for all manufacturing firms.[8] Often high profits are justified as a reward for the risk associated with highly varying profit levels. However, conglomerates that combine operations in several markets or industries, will experience less risk. This is the standard gain attributed to portfolio diversification or to farm enterprise diversification. The importance of this is that a reduction in the premium for risk is equivalent to a cut in the conglomerate's costs. This would increase social welfare if effective competition in the conglomerate's markets resulted in an equivalent reduction in the prices of its products. That this is not often the case is shown by Conrad and Plotkin [4, p. 40], for the more stable (riskless) profit levels are associated with high profits.[9]

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[5] It is significant to contrast X-efficiency with multi-plant efficiency. T.R. Savings [24] estimates that in relatively rare instances, efficiency gains of three to five percent of costs were available to multi-plant firms.

[6] Have these potential improvements in efficiency been realized? It is instructive to consider the relationship between productivity and industrial concentration. Large conglomerates occupy a disproportionate share of the top positions in the more concentrated industries [11, p. 49]. A recent National Industrial Conference Board study showed that, on the average, the largest four companies in an industry had higher rates of productivity than the remaining companies in the same industry and that industries with the highest productivity tended to have high concentration ratios, while those with low productivity tended to have low concentration ratios [1, p. 4]. Productivity was defined in terms of shipments per employee or value added per employee, the former explaining about six percent of the variation in industrial concentration and the latter explaining 20 percent. The reason many industries are relatively unconcentrated, of course, is that capital requirements for entry are very low. Often such industries are relatively labor intensive and for this reason have relatively low shipments or value added per employee, the measures of productivity used in the study. When these data were re-run for industries with four-firm concentration of 35 percent or over, there was a higher simple correlation between value added per employee and the Collins and Preston [3] cost-price margin ($R^2 = .36$) than between value added per employee and concentration ($R^2 = .09$). This strongly suggests that value added per employee, which has been used as a measure of productivity, is in fact a better measure of profitability and promotional costs. However, after profits and advertising were taken into account in a multiple correlation analysis, there was no relationship between value added per employee and industrial concentration [16].

[7] As quoted in [12, p. 48].

[8] The 50 largest food conglomerates owned nearly half of the assets in food manufacturing and earned 60 percent of the profits. The 78 companies with assets of

The progressiveness of conglomerates in the invention of new products and the innovation of new processes is subject to two contrasting views. First, it is maintained that only large conglomerates are able to finance the research and development needed to invent new products and to coordinate the complex activities required to introduce them in national distribution. Moreover, high conglomerate profits enable them to finance more research; and, to the extent conglomerates avoid price competition, they emphasize nonprice competition through new and improved products. A second view is that large conglomerates are not essential to discovering and introducing new products [11, p. 64]. Large firms often resist the introduction of major new products and processes because of investments sunk into existing product facilities. Institutionalized inventions at large corporate research laboratories are unlikely to generate significant deviations from conventional products and practices. There have been a

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over $1 billion in 1968 held 43 percent of all assets in U. S. manufacturing and earned 49 percent of the profits [11, pp. 47–49]. These higher profits may be justified as merely a private transfer from single industry oligopolists to multi-industry conglomerates, with no social gain or loss. Beyond this, conglomerates are more likely to possess the retained financial resources needed to enter additional highly concentrated high profit industries, virtually closed to new firm entry. Oligopolists in these industries will, as a result, tend to behave more competitively than before in pricing their products in the hope of deterring the potential competition of the conglomerates. But we are deluding ourselves if we think that the potential competition of conglomerates is equivalent to new firm entry. This is because conglomerates tend to have a higher profit objective than most American industries realize [13]. Critics have pointed out that the capital bottled up by conglomerates in search for high profit opportunities is unavailable for many socially worthwhile investments such as low income housing, which may have lower returns than conglomerate profit objectives.

[9] Analysis of the relationship between level of profit and inflation shows how conglomerates' excess profits have contributed to the inflationary spiral. For example, when manufacturing profits average 10.1 percent of net worth, we may expect an annual inflation rate of only one percent. When profits rise to 14.6 percent, the inflation rate rises to three percent [22, p. 109]. These calculations are based on an equation that assumes unchanged unemployment rate at four percent, unchanged income distribution and labor force distribution, and appropriate relative price shifts, with wages in all sectors of the economy changing at the same rate as those in manufacturing and a three percent rate of productivity growth.

large number of empirical studies in recent years.[10] While there is not complete agreement, Scherer concludes that "these findings . . . raise doubts whether the big, monopolistic, conglomerate corporation is as efficient an engine of technological change as disciples of Schumpeter (including myself) have supposed it to be" [25, pp. 1121–22].

This raises an important question concerning the selling costs of conglomerates. Do the requirements and advantages of large-scale advertising, rather than technology, give large conglomerates a special advantage? Table 1 shows the number of products added by 25 leading food

Table 1. Industrial entry and exit by 25 large food conglomerates, 1950 to 1966

Firm	Number of different industries[a]			
	In 1950	Dropped after 1950	Added after 1950	
			by merger	by internal expansion
Consolidated Foods	4	2	11	0
Beatrice Foods	7	1	8	1
Pepsico	3	0	8	0
American Tobacco	1	0	6	0
Borden	11	1	5	3
General Mills	3	0	5	0
Corn Products	3	0	5	1
National Biscuit	6	0	5	0
Pet Milk	5	0	5	0
Continental Baking	2	0	4	0
H. J. Heinz	4	0	4	0
Procter and Gamble	2	0	4	0
R. J. Reynolds	1	0	4	0
Coca-Cola	2	0	3	0
Hunt Foods	2	1	3	0
Pillsbury	2	1	2	2
Campbell Soup	2	0	2	1
General Foods	13	2	2	1
Carnation	6	0	2	0
Ralston Purina	3	0	2	0
Standard Brands	4	0	2	0
Unilever	6	0	1	2
National Dairy	9	0	1	1
Beech-Nut	3	0	1	0
Foremost	5	0	1	0
Total	109	8	96	12

[a] An industry is defined as a four-digit category in the Standard Industry Classification, Bureau of Census.
Source: [20, p. 125].

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[10] Students of the problem owe a debt of gratitude to the Senate Subcommittee on Antitrust and Monopoly and its chairman, Senator Philip A. Hart (Michigan), for the exhaustive hearings it has held on the subject of the role of technology and industrial organization. These hearings have reviewed nearly all of the recent authoritative work on this subject [5].

manufacturers through acquisitions between 1955 and 1966. These food conglomerates were in 109 different industries in 1950, and by 1966 they had dropped 8 of these while adding 108 more, 90 percent by merger. This suggests that product diversification by these large food conglomerates doubled in a decade, not because of their superior research ability, but through merger. Table 2 shows that for brands acquired by the 25 large food conglomerates, advertising support was nearly doubled in the first full year after acquisition, from $22.7 million to $43 million.[11] As a result, there has been an increasing concentration of food advertising expenditure in the large conglomerate [20, p. 68]. While advertising as a percent of sales remained almost constant for small food corporations between 1947 and 1961, the largest food conglomerates more than doubled their spending on advertising relatives to sales. The largest food conglomerates spend relatively more on advertising than smaller companies and, because of volume discounts and other advantages, this spending results in more advertising impact.[12]

Table 2. Changes in level of conglomerate advertising support provided brands when acquired, 1950 to 1964

Year	Network TV	Spot TV	Magazines	Newspapers	Total
	million dollars				
Year prior to acquisition	5.4	7.9	6.2	3.2	22.7
First full calendar year after acquisition	7.9	17.1	8.2	9.8	43.0

Source: [20, p. 126].

Finally, it seems clear that large conglomerates are able to engage in competitive strategies not open to lesser enterprises. We have illustrated the fact that increasing conglomeration raises several important economic problems. It can short-circuit the "market test" upon which we rely so heavily in an effectively functioning market economy. But there are two sides to every coin. Large conglomerates are able to undertake product promotion tasks that would exhaust the resources of smaller concerns and thereby may improve industrial performance. It is imperative that we develop more and better understanding of the nature and significance of large conglomerates. This will require much more study and reappraisal of the problem in the years ahead.

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[11] Williamson has hypothesized that "an efficient procedure by which to introduce new products is for the initial development and market testing to be performed by small firms (perhaps new entrants) in an industry, the successful developments then to be acquired, possibly through merger, for subsequent marketing by a large, multidivision firm" [27, pp. 1115–16]. For a contrasting view of mergers, see Reid's findings [23, p. 1922] that the more actively firms merge, the more they tend to further the self-interests of managers rather than the interests of stockholders.

[12] This favorable treatment constitutes an important scale advantage for the large conglomerate. An advertising executive reported that large conglomerates, such as General Foods, would get their TV advertising at a cost of $2.50 per thousand households, while smaller advertisers would have to pay $3.50 to $4 for the same audience. This means that smaller advertisers would have to pay 40 to 60 percent more for the same coverage [20, p. 70].

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VIGNETTES: TOOLS FOR POLICY

CHAIRMAN: JOHN E. THOMPSON, SOUTH DAKOTA STATE UNIVERSITY

Pricing Milk in Federal Order Markets*

JEROME W. HAMMOND AND TRUMAN F. GRAF

TWO types of price series are used as the basis for pricing most of the approximately 54 billion pounds of milk regulated by federal milk orders in this country. They are: (a) *product price formulas,* which are calculated by multiplying prices for manufactured products, such as butter and non-fat dry milk or cheese, by yield factors and deducting a manufacturing allowance; and (b) *competitive pay price series,* which are prices paid farmers for manufacturing grade milk at non-regulated manufacturing milk plants.

Competitive price series that have been used include the "Midwest condensary" price, "local plant" averages, "U.S. average 3-product manufacturing grade milk" price, and the "Minnesota-Wisconsin" price.

The Minnesota-Wisconsin price series is most widely used. It is the basis for Class I prices in all but six of the 67 Federal milk orders in the country and is a factor in determining surplus class prices in about two-thirds of the federal milk order markets.

However, its validity has been questioned by various factions in the dairy industry. A difference of as little as one cent per hundredweight either way could alter farmers' milk receipts, by close to $5 million annually in federal milk order markets alone. Therefore, an analysis of this price series was felt to be of great importance. This paper summarizes such an analysis.

Representativeness of the Minnesota-Wisconsin Price Series

The sample of plants used in calculating the Minnesota-Wisconsin price series is designed to include a representative group of plants purchasing manufacturing grade milk in both states. If the sample is in fact representative, the announced Minnesota-Wisconsin price should closely approximate the average of prices reported paid at all manufacturing grade milk plants in the two states.

The analysis indicated that the Minnesota-Wisconsin price series is a good estimate of the final average reported prices. For the 77-month pe-

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* This paper is based on two previous publications by the authors [1, 2].

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riod, August, 1961 through December, 1967, the two prices were the same in 12 months and differed by one cent in 35 months. The maximum difference for the period was seven cents. For the entire period, the simple monthly average of final average reported prices in the two states exceeded the Minnesota-Wisconsin price series by .6 cents per hundredweight. Thus, the Minnesota-Wisconsin price series is quite representative of reported prices for Minnesota and Wisconsin.

Accuracy of Reported Prices

Although Minnesota-Wisconsin series prices are representative of average prices reported by all manufacturing grade milk plants in the two states, the charge has been made that the prices reported by plants are different from those they actually pay their producers. These differences can occur because of errors in butterfat testing and weighting, gains or losses on milk hauling by the plant, or the payment of patronage refunds by cooperatives after prices have been reported. The effect of each of these factors was measured in 52 representative Minnesota and Wisconsin manufacturing grade milk plants (26 in each state).

Butterfat Testing.—Results of this analysis indicated that 25 of the 26 plants in each state paid for less butterfat than they received from farmers and therefore quoted higher prices than were actually paid. Average understating of butterfat tests for sample plants was 1.76 percent in Minnesota, 1.38 percent in Wisconsin, and 1.56 percent in the combined states.

The average "overstatement" of milk prices, because of understating butterfat tests, was 4.4 cents per hundredweight in the Minnesota plants surveyed, 3.8 cents per hundredweight in the Wisconsin plants, and an average of 4.1 cents per hundredweight for all 52 Minnesota and Wisconsin plants.

Low paying plants overstated their price more than did high paying plants—five cents per hundredweight for low paying plants, compared with 3.9 cents for high paying plants in the two states combined. *Thus, upward bias in reported farm milk prices resulting from butterfat test error was not due to greater overstatement of price by high paying plants than by low paying plants. Instead the opposite situation prevailed.* Discrepancies exist between the amount of butterfat plants purchase from the farmers, and the amoung of butterfat they pay farmers for. The reason may be dishonesty or the highly technical nature of determining fat content or both.

Milk Hauling.—Profits or losses on milk hauling also influence prices received by milk producers. For example, if a plant incurs a loss on hauling, it is in effect subsidizing the producer on his hauling costs; therefore, reported prices will be lower than actual prices.

The average loss on hauling for all plants surveyed was 1.4 cents per hundredweight. Thus, on the average, producers were being subsidized by that amount, with the result that reported prices were 1.4 cents per hundredweight lower than actual prices paid.

Plants with highest pay prices were making an average profit of .3 cents per hundredweight on hauling. Reported prices by high paying plants were therefore overstated .3 cents per hundredweight as a result of profits on hauling. On the other hand, plants with lower prices had losses on hauling and were therefore subsidizing hauling. As a result, reported prices by these plants were an average of 2.3 cents per hundredweight lower than actual prices paid.

Patronage Refunds.—Cooperatives (which comprised 45 of the 52 plants) often allocate profits to producers at the end of the fiscal period in the form of patronage refunds. If, as claimed in principles of cooperation, they are additional payments for doing business, reported prices for milk will be understated.

The average cash dividend for all plants was 2.1 cents per hundredweight. On the average, then, plants understated prices by 2.1 cents per hundredweight as a result of patronage dividend policy.

The lowest pay price group in the two states paid the largest cash and total dividends per hundredweight—3.7 and 9.6 cents, respectively. This was more than one cent per hundredweight above the high price group. Thus, low paying plants understated prices more through patronage refunds than did high paying plants.

Thus, the net effect of the three factors on reported milk pay prices for the Minnesota and Wisconsin manufacturing grade milk plants was: butterfat test error, +4.1 cents per hundredweight; hauling subsidy, −1.4 cents per hundredweight; and cash dividends, −2.1 cents per hundredweight; net overall effect, +.6 cents per hundredweight.

On the average, then, prices reported paid by these 52 plants exceeded actual prices paid by .6 cents per hundredweight. Reported prices are therefore quite similar to actual prices when the effect of hauling subsidies and patronage refunds are balanced against butterfat test error. Hence, it can be concluded the Minnesota-Wisconsin series prices are quite similar to the actual prices paid.

Relationship Between Operating Variables for Milk Plants and Farm Milk Prices Paid by Plants

The relationship between the level of pay prices and characteristics of the firm and the market was analyzed by two methods—classification of various operating variables by level of pay prices and stepwise regression analysis.

The classification procedure indicated that several factors were related to level of pay price: cash dividends, percent of income from a given manufactured product, depreciation allowance per hundredweight of milk, equity ratios, current ratios, plant location, costs of processing, and seasonal variations in milk supplies. Multiple regression analysis indicated that percent of income from butter and powder, plant locations (from Chicago), and gain or loss on milk hauling, were significantly related to the level of pay prices.

Thus, although there is some relationship between plant operational procedures and the level of farm milk prices paid, use of competitive pay price series based on average prices paid by all plants would not necessarily be inequitable with respect to plant price obligations for milk used in either Class I (fluid) or Class II (manufactured products). Many operational and marketing factors affect the price a plant can afford to pay for milk, and some are offsetting. Others can be adjusted or nullified by specific operational or marketing action. The use of competitive pay price series in federal milk order pricing, therefore, is not in itself inappropriate on the basis that many plants cannot afford to pay these prices. Instead, use of competitive price series provides an incentive for plant management to make adjustments in operations that will allow it to pay the highest possible producer prices—an important outcome in itself.

Policy Implications

Although the analysis indicated that reported manufacturing grade milk prices are quite similar to actual prices, some differences do exist, particularly with respect to the effect of butterfat test error. More accuracy in reported prices could result in more accuracy in competitive pay price series and hence greater equity when these price series are used in federal milk order pricing. The following recommendations are advanced in the interest of greater accuracy:

1. More detail could be reported for price series that are used for various regulatory programs. Average hauling subsidies, separate can and bulk milk prices, some estimate of average cash patronage refunds, and average butterfat differentials would be useful. With respect to refunds, some average of refunds for the previous years could be applied to the series to adjust it to a competitive level. The same procedure might be recommended for hauling losses or gains. However, measurement of this component would be more difficult.

2. Separate butter-powder and cheese series could be reported for the Minnesota-Wisconsin plants. This would provide relief for plants that have difficulty changing from one product to another. In addition this would overcome the objection that regulated federal order handlers are

required to pay more for milk used in some manufactured dairly products than non-federal order manufacturing plants pay for milk in the same products.

3. Additional resources could be devoted to regulation of milk testing, weighting, and reporting to assure accurate reporting of milk prices and payment of these prices to producers. This may involve additional surveillance of plant operations and more frequent checking of equipment and methods. Research on testing procedures, changes in product yields and expected variation in yields are also needed. It is possible that a federal order for manufacturing grade milk could overcome many of the problems of inaccurate butterfat tests and weights.

We are working through our public policy programs to incorporate the results of this applied research into federal milk order pricing procedures, and to improve the accuracy and reliability of prices reported by dairy plants for use in price series. We feel this application of research results through public policy programs, will be of value to the dairy industry in insuring more reliable, accurate, and equitable milk price series. This in turn will result in greater stability and equity in milk prices generally, in price series, and in federal milk order prices.

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The Pure Theory of Government Aid to Agriculture

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THE main goal of agricultural policies of developed countries is to alleviate poverty on farms. The programs usually considered by governments to achieve this goal are (a) price-support, which can be described as shifting the demand for farm output outward; (b) acreage control; (c) subsidizing inputs; and (d) production controls. In order to examine the effectiveness of these aid programs, a model of the farm labor market is constructed.[1] Available econometric estimates for the United States are utilized by the model.

The Model

The model is based on the usual assumptions of aggregation [1, 3, and 4]. All variables are expressed in logarithms throughout the analysis. The unadjusted demand and supply functions for labor are:

$$W_d = a_1 + a_2L + a_3C \tag{1}$$

$$W_s = \bar{b}_1 + b_2L \tag{2}$$

where W, L, and C denote the farm wage rate, farm labor force, and capital, which includes land.

The vertical shift in the supply of labor is reflected in $\bar{b}_1$, Replacing $\bar{b}_1$ by $-b_2b_1$, where b_1 reflects the horizontal shift in the supply of labor, and solving for W and L, we obtain the following reduced forms:

$$W = \frac{a_1b_2}{d} + \frac{a_2b_2}{d}b_1 + \frac{b_2a_3}{d}C \tag{3}$$

$$L = \frac{a_1}{d} + \frac{b_2}{d}b_1 + \frac{a_3}{d}C \tag{4}$$

where $d = b_2 - a_2$.

Adjusting equations (3) and (4) for the assumption that the farm wage rate is equal to the marginal physical product of farm labor multiplied by the price of agricultural output, and introducing the following equations (in logarithms):

(5) Production function: $Q = k + (1 + a_2)L + a_3C$

(6) Demand for labor: $W_d = k + (1 + a_2) + a_2L + a_3C$

(7) Value marginal product: $W_d^* = W_d + P$

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[1] Part of this model was developed in another article [3].

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and

$$\text{(8)}\quad \text{Demand for final output:}\quad P = \frac{1}{\eta}Q - \frac{H}{\eta}$$

we obtain a complete model, where Q, k, W^*, P, and η denote agricultural output, the neutral shift in the production function, value marginal product of farm labor, the price of final output and price elasticity of final farm output, H, which will play a role later, is the horizontal shift in the demand for output.

By substituting the right side of (6) for W_d in (7), the right side of (5) for Q in (8), and the right side of (8) for P in (7), we obtain the *adjusted* form of a demand function for labor:

$$\text{(9)}\quad \begin{aligned} W_d^* = 1 + a_2 - \frac{H}{\eta} + \left(1 + \frac{1}{\eta}\right)k + \left[a_2\left(1 + \frac{1}{\eta}\right) + \frac{1}{\eta}\right]L \\ + a_3\left(1 + \frac{1}{\eta}\right)C \end{aligned}$$

Substituting the intercept and the coefficients of L and C in (9) for a_1, a_2, and a_3, respectively, in (3) and (4), we obtain:

$$\text{(10)}\quad \begin{aligned} W = M - \frac{b_2}{\eta\cdot D}H + \frac{\left[a_2\left(1 + \frac{1}{\eta}\right) + \frac{1}{\eta}\right]b_2}{D}b_1 \\ + \frac{b_2 a_3\left(1 + \frac{1}{\eta}\right)}{D}C \end{aligned}$$

$$\text{(11)}\quad L = N - \frac{1}{\eta\cdot D}H + \frac{b_2}{D}b_1 + \frac{a_3\left(1 + \frac{1}{\eta}\right)}{D}\cdot C$$

where

$$D = b_2 - \left[a_2\left(1 + \frac{1}{\eta}\right) + \frac{1}{\eta}\right]$$

and M and N are constants.

Note that capital and land are treated by the model as exogenous factors. Since land is a fixed input, and since the process of capital formation on farms is relatively slow, such a treatment is justified in the short run.

In order to estimate the value of the coefficients appearing in equations (10) and (11), use is made of available econometric estimates that have received substantial acceptance in the agricultural economics literature [1, 2, 4, 5, and 6].

The values of the econometric estimates are

Parameter		Econometric estimate
Price elasticity of demand for farm output (η)		−0.25
Coefficient of labor in the production function ($1+a_2$)		0.50
Coefficient of capital (a_3):	Total capital	0.30
	Land	0.15
Reciprocal of supply elasticity of farm labor (b_2)		0.30, 1.00

The estimated values of the coefficients in equations (10) and (11) are shown in Table 1.

Table 1. Estimated values of coefficients in equations (10) and (11)

The Value of b_2 (Reciprocal of supply elasticity of labor)	Coefficients of			
	H A shift in demand for farm output	b_1 A shift in supply of farm labor	*C*	
			Farm capital including land	Farm land
	Farm wage equation (10)			
0.3	0.43	−0.27	−0.10	−0.05
1.0	1.14	−0.71	−0.26	−0.13
	Farm labor equation (11)			
0.3	1.43	0.11	−0.32	−0.16
1.0	1.14	0.29	−0.26	−0.13

Price Support

The price support program in the United States can be technically summarized as a 5 percent horizontal shift to the right in the demand for farm output. Assuming an elastic supply curve of farm labor ($b_2=0.3$), as indicated by Table 1, the effect of the price support program is to raise farm wages by about 2 percent, and increase farm employment by about 7 percent. For a less elastic supply curve of farm labor ($b_2=1.0$) the results are 6 and 6 percent, respectively. Thus, the costly price support program raises farm wages by a percentage which is somewhere between 2 and 6 percent. Regardless of the assumed supply-of-labor elasticity, it increases farm employment by 6–7 percent. Notice that the effect of the price support program on farm wages and employment is once and for all.

Acreage Control

Acreage control is the least effective among government aid programs. The coefficients of land in Table 1 are −0.05 and −0.13 in the farm wage equation, and −0.16 and −0.13 in the farm labor equation. Accordingly, an acreage control program is practically ineffective. A 10 percent reduction in land use would lead to somewhere between 0.5 to 1.3 percent increase in farm wages, and 1.3 to 1.6 increase in farm employment.

Subsidizing Inputs

The desirable effect of price support is a rise in the farm wage rate. The program is very costly, and its by-product, i.e., a higher employment level on farms is undesirable. The effects of acreage controls are similar in direction to that of price support; A rise in the wage rate coupled with a higher level of farm employment. Quantitatively the effects of acreage control are negligible.

Subsidizing capital inputs would lead farmers to use more capital in the long run. The coefficient of capital are negative and relatively small. They are estimated at -0.10 and -0.25 in the farm wage equation, and -0.32 and -0.26 in the farm labor equation. Accordingly, subsidizing capital inputs would give rise to two effects working in opposite direction than the programs mentioned above: Farm wage rate would further deteriorate, and farm employment would decrease. In this case, the first effect is undesirable, but the second effect is desirable.

Production Controls

In order to analyze production controls, the model has to be simplified. Recall again that all variables are expressed in logarithms. The derivative of the production function (5) with respect to labor can be written as

$$W_d = (1 + a_2) + Q - L \tag{12}$$

Equation (12) replaces equation (6) in the model. The demand for labor equation (12), together with equations (7) and (8) yield

$$W_d^* = 1 + a_2 - \frac{H}{\eta} - L + \left(1 + \frac{1}{\eta}\right)Q \tag{13}$$

The revised demand for labor equation (13) together with the supply equation of labor (2) yield the following reduced forms:

$$W = F + \frac{b_2\left(1 - \frac{1}{\eta}\right)}{1 + b_2} Q \tag{14}$$

$$L = G + \frac{1 + \frac{1}{\eta}}{1 + b_2} Q \tag{15}$$

where F and G are constants.

For a relatively elastic supply of labor ($b_2=0.3$), the coefficients of output are -0.7 in equation (14) and -2.3 in equation (15). Thus, if production controls leading to 10 percent reduction in farm output could have been effectively enforced, farm wages would have risen 7 percent and farm employment would have increased 23 percent. While a 7 percent increase in farm wages is welcome, a 23 percent increase in farm employment is a disaster. The percentage changes for low supply elasticity ($b_2=1.0$) are 15 and 15 percent, respectively.

Summary and Conclusions

The price support program is costly and somewhat effective only when low supply of labor elasticities are assumed. The acreage control program is practically ineffective. Subsidizing farm inputs leads to further deterioration of farm wages. However, unlike the two other programs, this program induces more farm out migration. Production controls can lead to desirable improvements in farm wages, but it affects adversely the process of farm outmigration, especially when high supply of labor elasticities are assumed.

The effects of each of the above programs are once and for all. A rightward shift in the supply of farm labor would cause the favorable effect of any of the above programs to dissipate over a short time period. This is indicated by the fact that the coefficients of b_1 (horizontal supply of labor shift) in the farm wage equation are negative. [3]. Notice, in Table 1, that the only variable that has the right sign needed for alleviating poverty on farms and at the same time inducing more farm outmigration is b_1. Hence, the best way to attack the farm problem is to induce a leftward shift in the supply of farm labor.

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Effects of Public Programs for Outdoor Recreation on Personal Income Distribution

LEONARD A. SHABMAN AND ROBERT J. KALTER

IN view of the multidimensional nature of the social welfare function, concern for the economically efficient provision of public goods and services should be coupled with equal concern for the equity effects of that provision [4]. More specifically, the personal income distribution effects of a project or program, as well as other equity considerations, must be analyzed if the planning process is to provide the information flows necessary for making public decisions consistent with the general welfare. Quantification of such effects make the trade-offs that exist between governmental objectives more explicit and point up the equity impact of programs undertaken wholly or partially for other reasons.

The Study

This paper reports on portions of an empirical study carried out with the use of fiscal 1968 data on New York State administered outdoor recreation expenditures[1]. Several different conceptual approaches were used and compared. The first utilizes a classical flow of funds form of analysis, tracing the redistribution effects of all state revenue devoted to outdoor recreation in a given year. In this approach, recreation expenditures were treated as gross transfer payments and, for each income class, were netted against tax and fee burdens imposed. The second approach analyzes the present value equity impact of incremental state investment in recreation facilities. Projected annual benefits, measured by a proxy for willingness to pay and converted to a present value basis, were used to estimate gross equity impacts and, for each income class, were netted against discounted costs.

Empirical considerations dictated that the income base used be household income before taxes, as defined for the National Recreation Surveys (NRS) [2, 3], and that the class definitions be: under \$3,000; \$3,000-5,999; \$6,000-9,999; \$10,000-14,999; \$15,000 and over. The distribution of households within these classes was taken from the Current Population Survey.

Data from the NRS were used to estimate the proportion of user days consumed by each income class for any given activity. These proportions, when multiplied by the total dollars spent by the state on that activity or

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by gross benefits, gave the amount of transfers and benefits, respectively, accruing to any one class. Summation of these flows over all activities gave gross transfers and benefits to each class. Columns 1 and 3 in Table 1 give the results of these calculations.

To determine net impacts, a measure of burden was needed. All state administered funds are raised through taxes and fees of various kinds. The amounts these separate revenue sources contributed to recreation was determined from available New York State budget data. Then, burden, as defined for the two approaches, was allocated for each revenue source to the income classes. For the net transfer payment approach, all state administered money spent for recreation in fiscal 1968 appeared on the cost side. For the net benefit approach, only capital investment and projected annual operating costs were allocated by class. In both cases, the allocation process was the same.

After allowance for shifting, the incidence of the tax by income class was determined from household possession, use, or purchase of the item on which the tax or fee was imposed. For example, tobacco consumption by income class served to indicate the proportion of the cigarette tax borne by each income class. This process was used for all the burdens that fell on individual households. Household purchases and use of products and services by class were taken from a recent Bureau of Labor Statistics survey and the *Survey of Consumer Finances.* The unshifted burden of the corporate income tax was assumed to fall in proportion to individual dividend income by class. Dividend income by class was taken from the Internal Revenue Service's *Statistics of Income 1966.* Summing all of the individual burdens over each class gave the total burden of taxes and fees.

Subtraction of burden from gross transfer payments gave the net transfer payment effect for fiscal 1968. The net benefit approach considers impact over time. In this case, costs and benefits to each class were discounted to present value and netted out. The procedure may be summarized:

$$W_j = \left[\sum_{t=1}^{T} \frac{B_j}{(1+i)^t} \right] - \left[\sum_{t=1}^{T} \frac{C_j}{(1+i)^t} + K_j \right]$$

where: W_j equals net present value benefits accruing to income class j; i equals the discount rate; T equals the time horizon; B_j equals the estimated annual benefits accruing to income class j; C_j equals estimated annual operating costs imposed on income class j; K_j equals capital costs imposed on income class j.

Columns 2 and 4 in Table 1 give the results of these calculations.

Table 1. Equity effects of New York State administered outdoor recreation expenditures

Income class / Form of analysis	Flow of funds[a]		Present value[b]	
	Gross transfers (1)	Net transfers[c] (2)	Gross benefits (3)	Net benefits (4)
	thousand dollars			
Under $3,000	9,255	5,543	13,071	10,368
$3,000–5,999	18,837	6,797	25,633	17,267
$6,000–9,999	23,930	2,836	32,189	17,614
$10,000–14,999	11,933	−4,257	23,277	12,207
$15,000 and over	15,045	−10,956	13,699	−3,462

[a] On a per household basis, gross transfers were $9.72, $15.27, $14.00, $10.29, and $22.04; net transfers were $5.82, $5.51, $1.66, −$3.67, and −$16.05.

[b] Based upon a 25-year time horizon, 4–5/8% discount rate, $1.50 per visitor day as a proxy for willingness to pay, and proportional income classes over the time horizon. Not given on a per household basis because the absolute number of households in each class will vary over the time horizon.

[c] Summation does not add to zero because of rounding.

Conclusions

The flow of funds analysis revealed that the New York State outdoor recreation program does have an annual redistribution effect. The two upper income groups realized negative net transfer impacts, while the lower three groups obtained positive net transfers. The income brackets under $6,000 received over 80 percent of the total positive impact. The flow of funds approach, however, has the weakness of only examining the equity impacts of total expenditures for one time period, even though the capital investment portion of those expenditures could result in equity changes over a longer time horizon. Thus, when undertaking the economic analysis of investment portions of a program, the present value method would appear to be more appropriate

Using this approach, the analysis showed that the upper income group realizes negative net benefits while the four lower classes realize positive net benefits. However, positive net benefits are the smallest for the lower class and largest for the three middle income groups. Over 80 percent of positive net benefits accrue to the $3,000-14,999 brackets.

Thus, given the program being analyzed, ignoring considerations of quality, and assuming that per unit benefit values do not vary across classes, both approaches indicate that the lower and middle income groups receive positive equity impacts. However, abstracting from repayment principles, a different result emerges. The lowest income class does not utilize state provided recreation facilities to the extent of other classes on either an absolute or per household basis, and this is reflected in the values displayed in columns 1 and 3 of Table 1. Given the value judgment that state provided recreation services should be available to all income groups on an equal opportunity basis, this would appear to indicate that the lower income class, largely urban in New York State, either doesn't care to participate or lacks the opportunity for participation because of the inability to pay transportation costs and/or purchase equipment associated with recreation participation.

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Government Payments and the Distribution of Income in Agriculture

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FARM programs in the United States have long had the improvement of farm income as their professed goal. Explicit or implied in this goal has been the desire to adopt those farm policies that improve the income of low income farmers. In fact, Congress and farm organizations continue to use this justification for our farm legislation. However, recent publicity about extremely large payments to some producers and very small payments to others has caused many to question whether our farm programs have been an effective means of maintaining minimum farm income standards. It is the purpose of this paper to analyze the distributive effects of our agricultural programs and examine whether government payments have increased or reduced the inequality in the distribution of income in agriculture over the past few years.[1]

Analysis

In order to determine the effects of government payments on the distribution of income in agriculture, this study utilizes the conventional Lorenz curve analysis and the resulting Gini concentration ratio. The Lorenz curve plots the cumulative percent of farm income against the cumulative percent of farms receiving that income. The Gini ratio, and quantitative measure of inequality, is defined as the proportion of the area between the diagonal line of perfect equality and the Lorenz curve to the total area under the diagonal. The ratio lies between 0 (complete equality of distribution) and 1 (maximum concentration).

In computing the Gini ratios, farms were divided into six economic size classes according to the value of gross sales as reported in the *Farm Income Situation* [7]. Plotted against this was realized net farm income.[2] It is recognized that, if total money income were used or if unrealized income were included, the ratios would probably be of different magnitude from those resulting when realized net income is used. However, the important implication for this paper is not the size of the ratios but how the ratios change over time.

Table 1 shows the Gini ratios for the years 1959 through 1967 for realized net farm income. The general trend over this nine-year period was to-

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[1] There seems little doubt that farmers would probably have lower incomes in the absence of farm programs, but that is a separate question and not analyzed here.

[2] Realized net farm income includes government payments.

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Table 1. Gini concentration ratios of realized net farm income and government farm payments, 1959–1967

Year	Gini ratio	
	Realized net farm income	Government payments
1959	.484	.466
1960	.499	.474
1961	.513	.485
1962	.500	.494
1963	.531	.504
1964	.568	.506
1965	.548	.518
1966	.557	—
1967	.542	—

Source: [6, 7].

ward increasing inequality, but the increase was not steady. The largest ratio occurred in 1964. This trend can be compared with the Gini concentration ratios for total money income for select farm groups, which showed a general decline with large fluctuations over the years 1948–1959 [2].

What role have government payments played in this distribution pattern? The Gini concentration ratios of government payments for the same economic farm size classes were computed for 1959-1965 and are also shown in Table 1.[3] Government payments in this case include primarily price-support programs, allotment and land-retirement programs, and direct-payment programs.

A steady increase occurs in the government payments concentration ratios over the seven-year period, reflecting increased concentration of payments among large farmers. One might initially compare these coefficients with the corresponding coefficients for realized net farm income and conclude that, since the government payment ratios are always smaller, government payments decrease the disparity in the distribution of income during any one year. A similar relationship is also noted in the report of the Food and Fiber Commission [6, p. 191]. However, this comparison ignores the question of the effect of government payments on the distribution of farm income over time.

To answer this question, a simple regression relating the realized net income Gini ratio to the government payment Gini ratio was computed for the period 1959 to 1965. The results are as follows:

$$(\text{Net Income}) = -.154 + \underset{(3.58)}{1.37}\,(\text{Government Payments})$$

$$R^2 = .72 \qquad D.W. = 2.38$$

where the number in parenthesis is the t-ratio.

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[3] Data on an aggregate level are not readily available for 1966 and 1967.

This simple model indicates that 72 percent of the variation in the realized net farm income concentration ratios can be explained by the variation in the government payment ratios. That is, the concentration of net farm income is sensitive to the distribution of government payments. The general conclusion that farm programs worsen the existing distribution of income in agriculture has been implied before by Bonnen [1], Coffey [3], Herendeen [4], and McKee and Day [5]. However, none of these studies has explicitly tested the relationship between the concentration of net income and the concentration of government payments over several consecutive years.

The farm programs that were the largest and showed the greatest increase during this seven-year period were the Wheat Program and Feed Grain Program. In 1965 these two programs accounted for 78 percent of the government payments. Both Bonnen [1] and McKee and Day [5], in analyzing individual programs, concluded that wheat and feed grain payments are highly concentrated and that present policy trends probably do not reduce the inequality in income. Also, from 1959 to 1965 the payments under the Sugar Act increased, and Bonnen showed that the Gini concentration ratio for sugar cane payments in the United States is 0.8.

If data were available, it would be interesting to include the concentration ratios of government payments for 1966 and 1967. It appears that these ratios would probably be even larger, since payments under the Cotton Program increased over 1000 percent since 1965. Most of our very large farm payments, $50,000 and greater, go to cotton producers. Bonnen concludes that cotton payments are very highly concentrated and that the ratios increased from 1961 to 1964 [1].

Conclusions

In general, as government payments under U.S. farm programs become more highly concentrated over time, realized net farm income also becomes more highly concentrated. This is understandable, since the size of government payments is based on the amount of land or volume of output a farmer has; the small farmer has little of either upon which he can claim government subsidies. Nevertheless, the increasing concentration ratios indicate that the farm programs are inefficient instruments in helping the poor farmer break the poverty cycle. If the goal of our farm programs is to aid the poor farmer, we should give serious thought to redesigning the agriculture payment plans.

The recent proposal in Congress to limit the size of government payments to any one farm to $20,000 would reduce the disparity in farm income distribution but would not help the impoverished. Such adjustments in our present programs will affect only the recipients of these payments, the large commercial farmers, and will have little impact upon the poor if the money saved is taken out of agriculture. If we place priority on aiding the low income farmer, there are several program proposals available to handle this, for example, the negative income tax and family allowances. If it is also our desire to subsidize commercial agriculture because it is a critical industry and because of the high risks in farming, a more equitable approach may be through the Federal income tax system. Nevertheless, Congress, commercial farm organizations, and our policy makers should reevaluate our priorities in agriculture and consider new programs designed specifically to meet these priorities.

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Long-Term Versus Short-Term Land Retirement

A. Barry Carr

SINCE funds to control farm production and maintain prices are not unlimited, agricultural programs should be selected from among those that use Government funds most efficiently. The purpose of this paper is to evaluate the relative efficiency of annual versus long-term land retirement programs in removing the most production per dollar of Treasury cost.

To determine the theoretical efficiency of agricultural programs, we assume that a farmer is willing to divert his land or allotment whenever the Goverment payment equals or exceeds the difference between gross receipts and variable costs. Thus, the ratio of variable costs to gross returns is correlated with the amount of production removed per dollar of payment. Programs that are associated with a high variable cost will give a higher efficiency. Efficiency increases as the time period of the program is extended and more the the farmers' costs become variable. Hence, the greater theoretical efficiency of long-term retirement over a yearly diversion program.

Often a discrepancy is observed between the theoretically computed payment that would induce program participation and the amount that farmers state would actually be required. In some cases, farmers may require more than the theoretically computed payment to divert their land from production. This payment premium may be greatest for long-term programs. Farmers tend to shy away from long-term contracts because of their inflexibility over time. Short-term diversion, which is favored by more farmers, has a lower variable cost situation and a smaller theoretical efficiency.

The gap between the theoretical payment and the payment asked by farmers for participation was gauged by data from a survey of 198 Oklahoma dryland farmers eligible for the wheat and/or feed grain programs. The sample was distributed proportionately over four randomly selected countries—one country from each of the four major agricultural areas of western Oklahoma. Within each county, names of owner-operators and operators were randomly drawn from the ASCS county records.

The cropland available was divided by the farmer into three quality categories. The variable cost of producing wheat and grain sorghum and

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the yields associated with each land category were also estimated by the farmer. Because the available allotments and bases are less than the total cropland on each farm, certain assumptions are necessary to lend consistency to the analysis. Some of these farms also had a cotton allotment. It will be assumed that the maximum permitted cotton will be grown on the best land. Wheat and grain sorghum will have second and third priorities respectively on the best land. There is sufficient of the best and average land to grow the entire wheat allotment. All grain sorghum would be grown on average quality land. Diverted or idle land, hay, pasture, and noncontrolled crops have a residual claim on the lower quality land categories. A breakdown of acreages, yields, and costs are given in Table 1.

The theoretical payment required to obtain participation in a retirement program was assumed earlier to be the difference between gross receipts and variable costs. Table 2 gives the theoretical payments for a one-year diversion when wheat is supported at $2 per bushel and grain sorghum at $2 per hundredweight. A theoretical payment could not be computed for five-year and ten-year programs because of a lack of variable costs data for these time periods. But assuming no changes in yields

Table 1. Descriptive parameters of farm sample

Item	County			
	Grant	Harper	Tillman	Texas
Farms (number)	73	33	47	45
Cropland (acres)	399	653	420	650
1967 cotton allotment (acres)	0	0	65	0
1967 wheat allotment (acres)	279	430	221	390
1967 feed grain base (acres)	29	87	28	110
1967 ASCS project wheat yield (bushels)	27.6	16.3	28.1	17.4
1967 ASCS project sorghum yield (bushels)	31.7	25.8	38.6	35.0
Best quality cropland (acres)	210	295	175	181
Cotton (acres)	0	0	52	0
Wheat (acres)	210	295	123	181
Wheat yield (bushels)	32.4	21.5	29.4	17.6
Wheat variable cost[a] (dollars per acre)	17.03	9.74	17.34	9.79
Average quality cropland (acres)	131	261	157	349
Wheat (acres)	69	135	98	209
Wheat yield (bushels)	24.9	15.6	24.7	14.7
Wheat variable cost[a] (dollars per acre)	17.33	9.64	17.72	9.94
Grain sorghum (acres)	29	87	28	110
Sorghum yield (bushels)	29.7	19.8	37.5	26.8
Sorghum variable cost[a] (dollars per acre)	16.00	9.33	15.00	9.28

[a] Variable costs include seed, fertilizer, hired labor, chemicals, machinery repairs, and fuel, custom harvesting, and hauling. Excluded from production costs are the operator labor, unpaid family labor, and land costs.

Table 2. **Comparison of theoretical payments and average payments required by farmers to retire entire wheat allotment or grain sorghum base over three time periods**

Item	County			
	Grant	Harper	Tillman	Texas
	dollars per acre			
Wheat allotment:				
Theoretical 1-year	43.99	29.59	37.11	22.22
Farmers' asking rates				
1-year	39.72	23.02[a]	32.89[a]	22.06
5-year	41.29	19.93	28.25	21.04
10-year	42.00	17.92[a]	29.04[a]	21.16
Grain sorghum base:				
Theoretical 1-year	17.26	12.85	27.00	20.74
Farmers' asking rates				
1-year	35.02	16.80	22.72	24.05[a]
5-year	32.76	17.33	24.07	21.28
10-year	33.65	17.33	24.64	21.11[a]

[a] The 1-year and 10-year mean payments are significantly different at the 5 percent level when tested with the "*t*" test procedure adjusted for unpaired observations and unequal variances.

and prices, the longer run theoretical payments would be lower than the value given for one year.

Each farmer was asked what payment he would require to divert entirely to wheat allotment or grain sorghum base for one year. He was also asked what payment he would need to retire his allotment or base for a five-year and ten-year period. In addition to not producing the crop, he would be required to divert to a soil conserving use an equivalent acreage of cropland. Table 2 shows the payment rates per acre reported by farmers in each county. It must be recognized that the estimates given by farmers in this study may not accurately correspond with their actions if they were making a decision in an actual program situation.

Because of the effects on cost of production, long-run retirement programs were hypothesized to be less expensive and, hence, more efficient in use of Government funds. The most significant reduction in payments that farmers said they would accept when changing from annual to long-term retirement was for wheat allotments in Harper County. Smaller but still significant reductions occurred for wheat allotments in Tillman County and grain sorghum bases in Texas County. None of the other differences in the average payments required was statistically significant.

A comparison of the one-year and ten-year program costs, based on farmers' asking rates, for the total wheat and grain sorghum acreage on all farms in the study shows a slight efficiency advantage for the long-term program. To retire the entire wheat allotment on all 198 farms in the four counties for one year would cost $1,864,411. If the same allotments were retired for a ten-year period, the annual cost would be $81,716 less, a reduction 4.4 percent. Retiring all of the grain sorghum bases for one year would cost $271,318. The annual cost of the ten-year program would be $13,407 less, or 4.9 percent.

It might be expected that the farmer's long-run price expectations would affect the term structure of his required retirement payments. The data showed no such correlation. Harper County had the highest five-year wheat price expectation, $2.03 per bushel; yet it showed the largest reduction in diversion payment required over time. Grant County farmers anticipated in five years a price of only $1.72 per bushel; yet they would require a higher payment rate for the long-run program than for one-year retirement.

The relationship between the theoretical payment and the farmers' asking payment for a one-year program is interesting. Wheat usually is the cash crop. Apparently, farmers were willing to accept a lower return to avoid the associated risks. They were willing to accept a lower retirement payment because it was sure. Grain sorghum usually is fed or grazed on the farm rather than sold. If this base were to be retired, farmers would have to make costly adjustments in their livestock programs. They may impute a higher return to grain sorghum fed through livestock than would be obtainable on a cash market. This would probably explain why farmers in this area often require a higher payment for diverting sorghum than might otherwise be expected.

Based on conditions in Oklahoma, these data seem to justify the use of long-term allotment and base retirement programs where they are accepted by farmers. Maximum efficiency in the use of Government funds would likely be achieved where farmers have been given the choice of one, five, or ten-year programs on a sealed bid basis. Bids would be accepted first where the most production would be removed per dollar of payment. Individual farmers could vote their time preference through their bids. The Government could discriminate between bids so as to minimize the cost of a specified reduction in output.

TOOLS OF OUR TRADE: FARM MANAGEMENT

CHAIRMAN: RAY BILLINGSLEY, TEXAS A&M UNIVERSITY

Returns to Farm Resources

DON BOSTWICK

IT seems to me that there are three basic questions suggested by this topic:

Can returns to farm production resources be isolated?
Can they be quantified?
Does it matter?

I could establish a new record for brevity by answering "yes" to all three of these questions and then sitting down. But this would require more discipline than I possess and would not be very convincing either. So I shall use my twenty minutes to outline the supporting arguments to my three positive answers.

Can Returns Be Isolated?

Resources are *goods* when they are of the stock kind and *services* when they are attributes that flow from goods. Farm production resources may be classified into physical, human, and financial resource sets. The set of physical resources includes those members that are physical and nonhuman, and that are used in the production process. Examples are land, machinery, livestock, fertilizer, fences, and stock water ponds.

The set of human resources includes those attributes of people that are used in the production process. Examples are labor, skills used in the management of production resources, and those of the entrepreneur who arranges the availability of resources for production.

The resources included in the physical and human sets may be subjected to value transforms and then become members of the set of financial resources, which also includes such members as cash money and other certificates of value.

In financial management research, the resources used in farm production are viewed as serving the five distinct functions of investment, ownership, labor, management, and entrepreneurship. It is the primary task of this paper to establish the system by which all returns to farm production may be allocated among these five functions.

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Investment

Money is the index by which value transforms are applied to otherwise disparate resources, such as bushels of seed, tractor-hours, and dollars of investment. But money is indifferent to the source of its control and to the kind of exchange it serves. Money is not self-allocating, it does not automatically exchange itself for that resource having the highest marginal return in production. Financial decisions are made by people, and the ex-post facto results of the decisions cannot be blamed on the money used in an exchange.

Investment is a process of exchanging a quantity of money for a promise of a greater quantity in return. Interest is the difference between the quantity exchanged and the quantity eventually paid back. An investment is uniquely defined by the quantity of money exchanged and by the conditions attached to the exchange contract. Since money is indifferent to its exchange conditions, any given dollar cannot have a higher return for one user than for another in the same use. To assume that a dollar in one checking account is in any way more or less valuable than a dollar in any other checking account is to open the door to conceptual anarchy in economic analysis—or to belief in magic.

An investment returns to the investor exactly that rate fixed by the contractural agreement governing the investment. The return to an endogenous investment is presumed to be the same as the rate that would have been paid for the same investment had exogenous money been exchanged. A farmer who uses exogenous investments in his production pays a return defined by contract. A farmer who uses endogenous money has an investment return defined by the market rate that he might have paid for the same investment in the marketplace.

Ownership

While investment is an economic activity of people, ownership is a legal condition with economic consequences. The owner of a resource performs the function of holding the legal right to its use and disposition. There is often, but not always, an investment required as a condition to the enjoyment of ownership.

Just as money is indifferent to the source of its control and to its use, so are the owned physical resources (goods) indifferent to their owner and to his use of them. The use decision is made by the person exercising the ownership function or by someone who has rented the use-right from the owner. Ownership returns are given by the market rate at which use-rights may be rented from the owner.

Net rent is the gross rent, as defined in the rental market, less such ownership costs as taxes, insurance, and maintenance, plus or minus changes in book value. Changes in book value may be negative for depreciable resources and for those that suffer obsolescence and destruction in use. Positive changes in book value might occur with goods that grow over time, such as replacement heifers and crops or land held by owners on an upward-trending market.

Labor

Labor is a somewhat peculiar resource in that one may contract a use-right to labor but may not own the person who provides the labor (slavery having been abolished). The labor function is provided by people, while machines provide work. There are markets in which the various qualities and kinds of labor have established exchange values. The return to exogenous (hired) labor is given by contractual agreement, while that for endogenous labor must be estimated by the appropriate market rate.

Management

It is the function of management to direct and control resources in the production process. The returns to the management function are given by the established market, but this return is not always easy to obtain. The market for managerial services in agriculture is less well developed than the markets for labor, ownership, and investment. Additionally, management is often paid a salary plus some percentage of the gross business. The gross is known only after the management function has been performed and can therefore only be some probability estimate ex ante. As long as the research problem is one of allocating returns ex post of the production process, there is no particular problem in valuing the management function. If the problem is to estimate returns ex ante of production, the management return must be expectational rather than contractually certain.

Entrepreneurship

The entrepreneur organizes and makes available the goods and services used in production. He takes the risk of allocating resources at more than their market price and of allocating them to purposes that are less than optimal. He also gets the financial rewards of making resources available at less than their market price and of allocating them at the economic margin. Entrepreneurship is the residual claimant to the financial returns generated by the farm production process. The return to entrepreneurship may be positive or negative in any given production cycle and may vary widely over several production cycles if there are significant stochastic elements in the production and resource pricing system.

The entrepreneurial return may be equated with the classical category of economic rent. If all factor and product markets are perfect, the entrepreneurial returns are a reasonable indicator of the extent to which the real world departs from the classical economic model.

In theory, each function can be provided by separate entities, in which case the entrepreneur would be the entity we usually label "the farmer," while the investment, ownership, labor, and management functions would all be hired exogenously. In theory, all five functions can be endogenous to a single farm firm. This is the paragon that we so often find in the currently received theory of the firm. The system of functional returns sketched here allows the researcher to calculate precise returns to all resources over the continuum between these two extremes.

Can Returns Be Quantified?

To deal with the question of quantification of returns to farm production resources, I have drawn on some published per-acre data that applied to the years 1965 and 1966 (see Appendix). Please do not quarrel over these numbers—I use them only as the stuff of an illustration. I have constructed three cases from the Illinois data to represent both extremes and a middle-point of the farm resource control continuum. The quantity of total resources allocated is the same in each case. Therefore, any difference in returns must be due to the way that resources are controlled.

Case 1: 100 percent investor

The operator owns all of the physical resources used on his corn farm, supplies all of his own labor, uses no risk investment from exogenous sources, and supplies all of the management. There are no exogenous returns because there are no exogenous resources supplied. The calculation of returns is summarized in the first column of Table 1.

Case 2: Pure renter

The operator rents the annual use-right to land and buildings from an exogenous owner, custom contracts the entire husbandry operation from plowing through storage of the crop, and uses exogenous money for the annual fertilizer and seed expenses. The operator furnishes the miscellaneous money and all of the management. The returns in this maximum rental case are summarized in the second column of Table 1. The returns to the exogenous suppliers of investment, ownership, and labor are identified, as well as those to the operator.

Case 3: Part-investor-owner

The operator owns the land and buildings, with an exogenous investment of 40 percent (a mortgage). The operator does not own a combine, but custom hires the corn harvest and half of the labor required in the growing and storing operations. He uses exogenous money for the annual

Table 1. Three resource control cases

Item	Returns and costs per acre		
	100 percent investor	Renter	66 percent investor
	dollars		
Cash farm income	134.55	134.55	134.55
Noncash farm income	25.00	0	25.00
Total farm income	159.55	134.55	159.55
Cash operating costs:			
Land hire	0	46.82	10.83
Machinery hire	0	27.50	6.90
Labor hire	0	0	3.08
Operators annual cost	50.00	31.57	42.38
Interest, operating credit	0	.92	.92
Total cash operating costs	50.00	106.81	64.11
Net returns to operators			
Endogenous resources	109.55	27.74	95.44
Investment return:			
To operator			
Land and buildings	27.07	0	16.24
Machinery	3.15	0	2.45
Operating capital	1.75	.18	2.25
Total to operator	31.97	.18	20.94
To exogenous investors	0	31.79	11.03
Ownership return:			
To operator			
Land and buildings	29.74	0	29.74
Machinery	16.18	0	12.59
Total to operator	45.92	0	42.33
To exogenous owners	0	45.92	3.59
Labor return:			
To operator	8.69	0	3.08
To exogenous worker	0	8.69	5.61
Management return	9.36	9.36	9.36
Entrepreneurial return	13.61	18.20	19.73
Endogenous resources			
Land and buildings	451.05	0	270.63
Machinery	45.00	0	35.00
Operating money	50.00	5.25	64.16
Labor and management	18.05	9.36	12.44
Total endogenous resources	564.10	14.61	382.23
Exogenous resources	0	549.49	181.78
Returns ratios (endogenous)			
Returns/resources	0.194	1.899	0.250
Average investment return (percent)	5.85	3.43	5.66
Average ownership return (percent)	9.26	0	13.85

fertilizer and seed expenses and supplies all of the management. The returns in this more "typical" case are summarized in the third column of Table 1.

The bottom rows of the table include a listing of the value of the endogenous resources supplied by the operator, and those supplied by exogenous sources. The proportions of resources are quite different in these three cases. The last rows of the table are three ratios that measure operator returns to endogenous resources (about equivalent to the traditional category of "net income") and the usual rates of return to investment and ownership. Note that the operator in Case 2 has a slight investment return and no ownership return at all; that there is a small ownership return in Case 3 to the owner of the combine; and that the investment return in Case 1 is wholly to the operator, while in Case 3 it is split between the operator and the exogenous investors.

Does It Matter?

I hope that the data developed in the Table 1 speak for themselves, but I doubt that they do. I have found no farm production situations in which the system sketched above cannot be used to isolate and quantify returns to production resources. The Illinois data used here are detailed and make the accounting task a relatively easy one. If the base data were not so detailed, the researcher would have to fall back on interpolation and suffer the consequences in less reliable results.

In the final analysis, whether or not it matters that we can isolate and quantify resource returns must be a pragmatic valuation. I think that it matters, because the system allows us more understanding of real-world events than we otherwise seem to enjoy. The system allows us to generate useful insights into the production resource pricing phenomena that otherwise tend to appear either foolish or non-economic. We can add income tax and disinvestment variables to the above system and predict the growth or abandonment of land, cattle, and machinery leasing by operators. We can use this system to analyze the degree of perfection in various resource markets and to predict where the action will be, under assumed institutional changes.

It makes a difference whether a farm operator is a successfully leveraged entrepreneur, or a tractor driver who happens to own the tractor and the land it runs over, both free and clear. This difference is subject to economic analysis, even as Schumpeter thought it should be.

Appendix

Per Acre Base Data for Corn

Investment

Land: $400/acre investment; $600/acre current value.
Buildings and equipment: $24/acre current value.
Grain storage buildings: $29.62/acre current value.
Total investment value: land and buildings, $453.62.
Machinery, current value, $45 per acre.

Ownership

Land control, on share rent:
Gross rent, at one-half the crop, less one-half annual fertilizer and seed costs, $52.86.
Land taxes at .0122 of current value—$7.32.
Annual maintenance, buildings and equipment, $8.63.
Net rent on land, crop-share, $36.91.
Inventory changes, land:
Increase in land value = $25.00; depreciation on buildings and equipment = $5.10; net inventory change (noncash) = $19.90+.
Less investment return of $27.07/acre = net return to land ownership of $29.74/acre.

Machinery

Estimated gross rent = $24.48, less taxes of $0.65 = net rent on machinery inventory.
Inventory change: depreciation of $4.50 and investment return of $3.15.
Net return to machinery ownership = $16.18/acre.

Labor return

For growing, $5.82; for harvesting $2.53, for storing $0.34/acre.

Operating costs

For growing:	
tractor and machinery	$ 9.55
seed	3.74
annual fertilizer	18.22
manure	5.62
annual value phosphate	1.26
general crop expenses	3.99
Total growing expenses	$42.38
Harvesting:	
tractor	$ 1.08
custom hire	2.31
other machinery	4.23
Total harvesting expenses	$ 7.62
Total crop operating expenses	$50.00

Application of the Financial Management Function in the Family Size Farm Firm*

KENNETH R. KRAUSE

SUCCESS in family farm firms requires that the household farm-management complex make concurrent production and financing decisions to achieve realistic financial objectives set by the household. Economic theory of the firm has not evolved usable models in which the dynamics of production, capital, and finance are integrated [1, 5]. However, the increased rate of change in the mix of inputs used in production and marketing, lower profit margins per unit of output, firm growth, and income tax considerations are suggesting that researchers need improved insights on financial management, and farmers need improved financial management knowledge and skills. This paper is addressed to the newer areas of financial management in family-sized farm firms, a subarea and interrelated area of farm management.[1]

The Changing Role of Finance in the Farm Firm

The academic and research field of firm finance is evolving from one of describing instruments and institutions into a subdiscipline that encompasses development of rigorous financial strategies and analysis. Research, teaching, and application in farm firms now goes beyond analysis of procurement of funds to analysis of efficient capital utilization, which is an integrated part of the general management of a firm. The focus of farm firm finance is on risk-returns standards, the cost of capital, how the cost varies with financial decisions, the management of assets, the allocation of capital, and the valuation of the firm as a whole.

In the past, in farm management research and farmer decision making, considerable emphasis was placed on physical production of farm products. Addition to total cost or marginal cost of production provided a guide to determine the optimum level of production. Theory of the firm assumed an unlimited availability of equity funds, credit, or capital that is unrealistic in the real world. Marginal cost of finance is a useful criterion in finance decision making.[2] Instead of marginal revenue or returns from

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* Views expressed in this paper do not necessarily reflect those of the U. S. Department of Agriculture. Appreciation for review of an earlier draft is expressed to John Lee, Gordon Rodewald, and Allen Smith.

[1] Family size for purposes of this paper implies a farm firm in which a single family supplies the major part of management and labor. Application of the financial management function varies by size, input, and product mix in family size firms; however,

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sales, marginal return or efficiency of investment should be emphasized. The limit to profitable expansion of assets in the farm firm is reached when adding resources and money (marginal cost) equals the marginal returns to be obtained from the expanded firm [8].

The Household-Firm Complex

Limited attention has been given the household-firm complex in farm management research and teaching. The focus of attention has been upon management and management functions in the farm business. However, additional classification appears useful. The household and the farm firm may be viewed as separate entities. The household, some combination of man, wife, and children in family size farms, may be viewed as setting the financial and social objectives and goals. With less physical work by wives and children in the farm firm, the household farm firm separation is increasing. However, the two are coming together to an even greater extent through increasing cash withdrawal needs of the household from the farm firm.

Financial management at the household level is broader and more all-inclusive than in the farm firm. Successful financial management, whether at household or firm level, implies the ability to achieve the financial objectives set forth. In addition to allocation of resources for the farm firm, the household needs to consider farm and nonfarm business activities and investments, leverage-risk exposure levels, the types of farming to engage in, and household consumption levels.

The household may be viewed as the entrepreneurial unit in providing resources for the farm business. Farm management comes into play in the context of carrying out the objectives for the farm business, which are set at the entrepreneurial level within the confines of an existing set of resources; to change the set of resources requires a household, entrepreneurial management interplay. When the resource bundle is changed and particularly when expanded, the management input may have to change; it may be continuous or discontinuous.

Most important, farm firm financial decisions are long term and involve setting financial objectives for the farm firm, desired growth rates, growth paths in terms of commodity selection, internal and external financing, and how resources are to be controlled; e.g., through ownership, rental, or hire of a package of services, or some combination of the three.

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major differences in application of the financial management function appear between family size firms and larger than family size firms. The differences are in part due to the nature of the credit and equity markets used by various sizes and types of firms, the level at which contracts are negotiated between farm and physical input and marketing firms, and the management decision-making aids available to family size firms as opposed to very large firms.

[2] Several items enter into determining the marginal cost of finance in a dynamic context such as the interest rate, finance charge, opportunity cost on equity and the cost of liquidity.

The farm business has been the predominant type of business and has claimed most of the ownership and investment activities of the household-entrepreneurial complex in family size farms. However, nonfarm resource ownership and investments are made at the household level and may become more competitive with the farm business as the family farm household becomes more knowledgeable on nonfarm investments. The financial management function for nonfarm activities is similar to farm activities; specific application changes with the nature of ownership, investment, and the dynamics of the specific nonfarm activity.

Financial management is an integral part of the overall household planning and entrepreneurial process. It is particularly relevant in analyzing potentials relative to goals selected by the household, devising resource acquisition and allocation strategies to bring closure between potentials and goals, establishing operating goals, measuring results against goals, and instituting adjustments to reach desired goals.

The Farm Financial Management Function

Examples of several interdependent management functions of the farm firm are: (1) physical production, (2) labor, (3) procurement, (4) marketing, (5) financial, and (6) overall coordination and direction of the business. The household or entrepreneurial unit performs or delegates each of the functions. In family size firms, the entrepreneurial role and all of the management functions are often vested in one individual. However, each function must be completed; and for research, teaching, and farm management purposes, we can single out the financial management functions and concentrate on them just as we previously focused upon production and labor management.

The farm finance function includes: (1) obtaining the desired flow of resource services and managing the services, which might include land, machinery, other capital stock and credit; (2) management of investments; (3) information flows, which might include records, accounts, etc.; and (4) planning and control processes. In terms of decision making, the financial management function involves investment decisions and financing decisions. Major investment decisions for the farm business are made at the household level and are concerned with the magnitude and composition of owned assets and the business-risk mix of the firm and relate to operation and expansion strategies [2, 4, 7, 11].

Financing decisions involve the use of equity and credit and become important when production and capital theories are integrated since financial resources require allocation and management; the firm faces financial constraints imposed by the current state and uncertainty of new technology and the input and product markets. Investment and financing decisions are related and must be determined simultaneously, since investment in resources relates to credit availability, leverage, risk exposure, capital cost, and income. Financing and investment decisions in family firms are often made in cooperation with a financial institution, resource supplier, or marketing firm.

Economies in Financial Management

Several continuous processes are involved in farm financial management, which is now demanding more time and improved interpersonal skills on the part of family size farmers.

Advances in business management concepts and techniques are developing a recognized area of business technology that can be applied to farm investment and finance decisions. In industrial firms, planning and daily operations are often separated; e.g., the executive overall management role is organized around functions, whereas daily decisions in terms of financing immediate product production and marketing are organized around commodities. Economies of management may be achieved in both executive and operating roles [9]. In family size firms, long-term financial planning is an executive function; economies in the executive function are conceptually available in terms of long-term planning—both for a production period and for intermediate and long-term life of the firm. Rigorous long-term executive plans provide a guide for daily executive decision making. Development of alternative long-term strategies, including knowledge of what resources will become available and under what terms, can provide short-term economies in the executive function; e.g., if plans and consequences are developed, the farm firm or household has only to examine immediate conditions in terms of long-term plans to make an executive decision.

Operating management is associated with the short-run operation of the farm business in terms of the physical production job and adjusting to changing climatic, input, and price conditions and resources that become available. Financial flexibilities and efficiency can be achieved in the short run in a setting of preplanned financial arrangements; e.g., prearranging for financing of fertilizer, machinery services, etc., that may be needed during a production period. Since weather, price relationships, and resource availability often change rapidly in the short run, the major financial management operating economies appear most likely to come from work that is done at the executive level prior to actual operation.

Public Assistance for Financial Management

Given the pressing public social demands on the domestic economy, public assistance for farm management work may have low priority for additional funds. However, given public research and public agencies that may be available for family farm business assistance, financial management should rate high on the priority list. Work both in assisting the farm family to achieve its financial goals and in assisting the public to achieve resource use goals would be useful [3]. Family farmers can obtain increased financial management capacity in several ways. Public agencies and institutions active in providing farm management assistance to farmers need to reevaluate their role and learn how to more effectively provide financial management assistance.

Farmers, in some cases, can reduce financial management time requirements through hire of mechanical tasks, such as recordkeeping, feed formulation, fertilization levels and mixes, and even decision making on what and how much to produce. However, farmers cannot generally hire financial management skills and integration of financial outcomes. Advances in electronic data processing and application through public establishments and private firms can assist farmers in both short- and long-run financial management work. The degree of public support for development and operation of electronic data processing for family size farmers, in which a highly skilled analyst plus supporting help may be needed for 20 to 30 farmers, has not been determined. However, the importance of potential developments suggest that more analysis on the public role should take place soon.

In the absence of public guidance, individual family size firms will continue to use and exploit resources that will optimize individual financial and personal objectives but thay may be in conflict with public objectives. Only two areas for consideration are discussed: (1) real estate use and (2) credit use and availability. From both an individual and public point of view, the real estate rental and sales markets are not well developed and few farmers know about real estate available for sale or rent outside of their immediate neighborhoods.[3] Few family farmers conduct rigorous short- or long-run analyses of the availability of land for purchase, cash rent, or share lease in their geographic areas as part of their short- and long-term planning. What would be the payoff from teaching farmers how to evaluate the availability of resources? What would be the payoff from developing improved market news of available farm investments and financial resources?

Measures or indices of family size farmers' ability to use credit and to obtain various rates of growth have not been developed.[4] Without even crude measures, individual credit institutions have limited opportunity to bid on credit extension to a large number of farm households. Farmers, likewise, have very limited knowledge of credit that could be available to them under various terms. Improved measures of success in farm credit use should be useful to farmers and farm lenders and other resource suppliers.

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[3] Comparison with advances in reporting market news for livestock, grains, fruits and vegetables, and even farm credit, where public assistance helps to provide daily price and quantity and quality quotations, indicates that information on real estate and credit markets could be improved.

[4] Advances in industrial development and application of subprofessional, professional, and management selection scales appear to hold potential application in the farm credit field. Credit extension indices might include probabilities of repayment for various types of enterprises and loan magnitudes [6].

Summary

The financial management function does not replace traditional management functions and processes; rather it modifies and adds to the overall role of management in the family size farm firm. Financial management will require more management time and improved skills and information.

Farm entrepreneurs may need to redirect emphasis from physical production, where extensive knowledge of alternative outcomes is available, to the financial management function, where knowledge is not readily available and where farmers have limited knowledge of credit and capital availability and alternative outcomes from use of credit and capital. Family size farmers have become adept at developing physical production strategies to cope with climatic and disease phenomena. They now need to develop equal sophistication on financial management strategies to meet the household's financial objectives.

Agricultural economics research alone and with interdisciplinary efforts can assist the farm family with farm financial management research through more clearly identifying household financial goals; through analysis of alternative ownership, investment and operating strategies; and through evaluation of required managerial capacity. Research can also help to design more effective ways for farmers to gain access to managerial capacity and more effective educational programs. Such work can yield larger dividends in the future than past work on production strategies is now yielding. Rigorous attention to means of resolving possible conflicts between private financial objectives and public objectives can help to insure an improved domestic environment.

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Income Tax Planning for Farmers*

HOY F. CARMAN

AN assignment to discuss income tax planning for farmers at a time when major tax reforms are being considered is a difficult, but, I must add, interesting task. I use the word interesting, but one can rest assured that many tax advisors, management companies, and investors use stronger descriptive terms. Football coaches respond to rule changes with new or revised strategies. I expect tax reform to lengthen the working day of many tax consultants as they devise new "quick openers" and "end sweeps."

This paper will discuss some farm tax planning opportunities that have existed during the last several years. Tax provisions used in tax loss farming will be emphasized. The principal features of proposed tax reforms as applied to agriculture will be summarized and some probable effects will be discussed.

Special Farm Tax Provisions

Farmers face the same problems as other taxpayers, plus a few that are unique.[1] But special income tax provisions that are applicable to farmers offer favorable tax planning opportunities as well as problems—opportunities that revolve primarily around the use of cash accounting. Cash accounting, combined with accelerated depreciation, full deductibility of farm losses from income, timing of income and expenses, and capital gains provisions on agricultural assets, has been used by farmers and ranchers as well as nonfarm investors to maximize after-tax income.

Ordinary income can be shifted to capital gains in a fairly systematic manner with proper planning. The income shifting opportunity is afforded to farmers building up a herd of livestock, establishing an orchard or vineyard, or improving a parcel of land with soil and water conservation improvements. Most expenses, even though they add to the value of these assets, are deductible at the time incurred.[2]

Tax Planning

I have found surprisingly little written on farm tax planning with a planning horizon of more than two tax years.[3] Most publications dealing

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[*] Giannini Foundation Paper No. 296. I appreciate the helpful comments of Gerald W. Dean and A. Doyle Reed on an earlier draft of this paper.

[1] Baker has an interesting discussion of farm tax problems with reference to court cases [1, 2]. For good discussions of tax management for farmers, see [9, 11].

[2] The deduction in any tax year of expenditures of a capital nature for soil and water

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with farm income tax management are concerned with depreciation methods, timing receipt of income, timing of input purchases, and full deduction of expenses [8, 10, 15]. Farmers who recognize the need for longer term tax management have typically sought out professional services of tax consultants and management companies. Most farm tax provisions have wide applicability, but optimum utilization can be quite individualized.

Most farmers have benefited in one way or another from special farm income tax provisions. However, it is probably safe to say that few farmers have utilized these provisions in a systematic manner over time to convert ordinary income to capital gains.[4] Farmers have not traditionally found themselves in the highest tax brackets where the advantage of capital gains income is greatest. Tax consultants and management firms, however, were quick to recognize the value of agricultural enterprises such as citrus and cattle for their high income clients and devised programs that exploited farm tax laws. Promotional materials of management companies and articles in business publications, such as *Fortune* and *The Wall Street Journal* have emphasized the tax advantages of agricultural investments [4, 3]. What high tax bracket investor can resist, for example, the detailed description of a stockbroker who realized a two-year after-tax return of 39 percent on a $35,000 investment in breeding cattle [3].[5] The same story reported that "at least eight corporations, plus dozens of individual farmers who also manage property for a fee, now handle well over $100 million of investments for more than 5,000 people." Much of the growth of these firms has occurred during the last three or four years.

Tax Loss Farming

Capital gains provisions, tax treatment of certain types of farm expenses, and cash accounting form the basis for successful "tax loss farming" or "tax sheltered investment in agriculture."[6] The incentive for tax sheltered investments is provided by the difference in tax rates between ordinary income and capital gains.

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conservation is limited to 25 percent of gross income from farming for the year. Any unused deduction can be carried over to succeeding years [15, p. 39]. Land clearing expenditures can also be deducted. The deduction in any year cannot exceed $5,000 or 25 percent of taxable income from farming, whichever is less, and the balance must be capitalized [15, p. 23].

[3] A noteworthy exception is the excellent analysis by Dean and Carter [7].

[4] I know of a farmer who has built up a substantial net worth while paying no federal income taxes.

[5] A budgeted example for a six-year investment in beef breeding cattle, based on cost, price, and tax levels effective in 1967, illustrated that an investor in the 70 percent tax bracket could realize a simple after-tax return of approximately 14 percent on invested capital [6]. The rate of return decreases for investors in lower tax brackets.

[6] Other tax provisions form the basis for very popular tax sheltered investments in apartment houses and in the oil industry, e.g., liberal depreciation rules and percentage depletion allowances.

Several agricultural enterprises offer tax shelter opportunities. These include livestock, development of orchards, groves, and vineyards, and some land improvements. The method of operation is similar for each enterprise. The farmer or investor builds up a herd of breeding or dairy animals or improves land. Cash accounting is used, and expenses are deducted from income, farm or nonfarm, at the time incurred. The tax basis of the raised livestock held for breeding or dairy purposes and the land improvements is zero. Thus, any gain realized from the sale of these assets is capital gains. After-tax returns for these investments increase as the marginal income tax bracket of the owner increases and as the ratio of capital gains to expenses increases.[7] Careful planning can result in an attractive return to the nonfarm investor from tax sheltered investments in agriculture. A growth-minded farmer or rancher can also use these tax provisions to build up his net worth with a minimum income tax liability.

Tax shelter investments are much more profitable for high income than for low income taxpayers. This differential in profitability permits low income farmers to execute mutually advantageous contractual arrangements with high income investors. Contractual arrangements are facilitated by management companies who for a fee (tax deductible) arrange for farmers to care for the farm property of investors. Polson found that a group of Oklahoma ranchers had higher after-tax returns for each of the years 1962-1967 with cattle cared for under a contractual arrangement than with their own cattle [12]. It is important to note that the after-tax cost of establishing an orchard or improving land decreases with increases in the tax bracket of the developer. This presents interesting possibilities for orchard development. The level of taxable income of buyer and seller in seller-financed land sales is an important consideration since interest is tax deductible for the buyer but ordinary income for the seller. For a given outlay on an installment contract the buyer will prefer the highest permissible allocation of sales price to interest. Differences in tax brackets of the buyer and seller may make adjustments in the sales price and allocation to interest profitable for both parties to the contract.

Proposed Income Tax Law Changes

Agriculture is one of the areas chosen for early tax reform efforts. What started out as an effort to limit tax-loss farming by wealthy urban investors appears to have become an effort to tighten up income tax rules applicable to all farmers.

Let us briefly consider some tax reform proposals applicable to agriculture. A Treasury Department recommendation prepared during the Johnson Administration called for limiting to $15,000 the amount of farm losses that could be deducted from nonfarm income [13]. Senator Metcalf (D-Montana) introduced a bill in the Senate that also would limit the deduction of farm losses from nonfarm income but is more restrictive than the Treasury Department proposal. Under this bill, a taxpayer with $30,000 or more of nonfarm income could not deduct any losses from nonfarm income.[8] The impact of these proposals on most full-time farmers and ranchers would be minimal. Tax shelter investments in agriculture would be sharply curtailed under the Treasury proposal and would no longer be profitable under Senator Metcalf's bill.

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[7] For discussions of the effect of tax bracket and recovery of expenses on returns from tax shelter investments, see [5, 6].

A comprehensive tax reform bill has been passed by the U.S. House of Representatives and sent to the Senate. Under its provisions, as I have seen them reported, the size of individual tax shelter investments in agriculture would be limited. In addition, the incentive for tax shelter investing would be somewhat restricted by changes in tax rates and capital gains provisions. Tax rates would be reduced, the capital gains tax rate would be half of the ordinary rate but with no maximum, and the holding period to qualify for capital gains would be lengthened.

Limitation of tax loss farming would be accomplished with the requirement for an "Excess Deductions Account." Taxpayers with nonfarm income over $50,000 would have to place farm losses above $25,000 per year into this account. The taxpayer would then have to pay ordinary tax rates on the Excess Deductions Account before claiming capital gains on breeding livestock, orchards, and land improvements. It is also reported that the definition of a "hobby farmer" (who is denied write-off of losses) would be anyone who loses $25,000 or more annually from farming for a period of three years. These provisions would not affect the profitability of tax loss farming but would limit the size of individual investments. The provision of an Excess Deductions Account should have little effect on the full-time farmer.

A change in the rules governing capital gains on livestock would increase taxes for some farmers and ranchers but would have little effect on method or size of operation. It would require that livestock be held for at least one year after first being used for draft, dairy, or breeding purposes to qualify for capital gains. Depreciation on purchased livestock would become subject to recapture provisions as ordinary income when there is a profit on subsequent sales. Each of these provisions, if enacted, would reduce the profitability of tax shelter investments in livestock enterprises.

Gains in land values that are the result of soil and water conservation expenditures would be subject to ordinary income tax rates for five years after the expense was incurred. While I have seen nothing regarding orchard establishment expenses, it is reasonable to expect similar regulations. This would lengthen the holding period of some tax shelter investments in land but would have little effect on farmers improving land or establishing orchards.

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[8] The bill (S. 4059) provides that for a taxpayer engaged in farming, the deductions allowable shall not exceed the sum of (1) the adjusted farm gross income for the taxable year, and (2) the higher of either the amount of special deductions or $15,000 less the amount of nonfarm income over $15,000. These provisions will not apply to farmers using accrual accounting [14, pp. A-108 and A-109]. A companion bill (H.R. 19916) was introduced in the House of Representatives by Mr. Culver [14, pp. E-302 and E-303].

Summary

Profitable tax planning opportunities exist in agriculture, especially in the conversion of ordinary income to capital gains. Farmers have benefited from farm tax provisions but not in the spectacular manner of some wealthy urban investors. The tax reform bill passed by the U.S. House of Representatives would serve to reduce the size of tax shelter investments, as well as their profitability, while allowing farmers to continue their use of cash accounting. We have no way of knowing what action the Senate will take on tax reform. I feel confident, however, that even with tax reforms, farmers can profit from the type of income tax planning just described. Good financial records, familiarity with income tax law, and occasional professional advice will help score points in the tax management game.

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VIGNETTES: RURAL DEVELOPMENT, DEMOGRAPHY

CHAIRMAN: JAMES M. STEPP, CLEMSON UNIVERSITY

General Hospital Facilities in Michigan, 1965

LEON B. PERKINSON

IT IS commonly assumed that rural areas have fewer beds per 1,000 population than urban areas. With rapid net outmigration from rural areas, this supposition may be no longer true. The purpose of this study was to determine the availability of general hospital beds and the variation in availability by degree of rurality.

Licensed capacity, an approximation of facility quantity, of hospitals by type of bed, was obtained for each county.[1] Licensed capacity does not measure underutilization, overcrowding, or quality of facilities.

Non-public hospitals, such as military base hospitals, federal and state veterans' facilities, U. S. Public Health Service hospitals, and student health facilities, were excluded from the analysis. Mental, long term or rehabilitation, and tuberculosis (TB) beds for "public" hospitals were also excluded because of the specificity of location for such services. Hospitals with mental or TB facilities were located in counties with a town of 5,000 or more and within 25 miles of a Standard Metropolitan Statistical Area, with the exception of Marquette County. Marquette could be considered the central place of the Upper Peninsula. The long-term facilities were all located in areas with a town of at least 5,000 population or were within 25 miles of a SMSA.

Method

An ordinary least squares linear regression (OLS) was used in the analysis. The dependent variable was the number of general hospital beds per 1,000 population, and the independent variables were 13 socio-economic characteristics. This equation was processed through an OLS delete routine with a ten percent minimum significance required for each variable in the basic equation (equation 1, Table 1). Dummy (0,1) variables representing measures of rurality were added to the basic equation (equations 2-4, Table 1).

A non-linear (logarithmic) form was also used following the above steps,

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[1] Unpublished data supplied by the Michigan Department of Public Health.

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Table 1. Linear regression coefficients for four separate estimates of the number of hospital beds per 1,000 population, Michigan, 1965

Coefficient	Equation			
	1	2	3	4
Constant term	8.726* (1.544)[a]	7.907* (1.547)	9.480* (1.686)	8.878* (1.631)
Capital expenditures on health and hospitals per capita, 1962	+ .098* (.035)	+ .098* (.033)	+ .093* (.034)	+ .091* (.034)
Percentage change in population, 1950–1960	− .030*** (.016)	− .031*** (.016)	− .032*** (.016)	− .029*** (.016)
Percentage of the employed labor force working outside the country, 1959	− .069* (.019)	− .065* (.019)	− .056* (.019)	− .055* (.20)
Percentage of the population age 60 or more, 1960	− .252* (.094)	− .170*** (.099)	− .265** (.107)	− .246** (.108)
Existence of a town of 5,000 or more, 1960[b]		−1.067** (.470)	−1.485* (.500)	−1.256** (.480)
Geographic location, A[c]			− .273 (.314)	
Geographic location, B[c]			.360*** (.193)	
Distance from city, C[d]				− .165 (.306)
Distance from city, D[d]				+.310 (.177)***
Multiple correlation coefficient (R)	.5793	.6142	.6446	.6347
Coefficient of determination (R^2)	.3356	.3772	.4155	.4028
Coefficient of determination adjusted for degrees of freedom (R^2)	.3015	.3368	.3609	.3471
Standard error of estimate	1.863	1.815	1.782	1.801

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* Significant at the 1 percent level.

** Significant at the 5 percent level.

*** Significant at the 10 percent level.

[a] Terms in parentheses are the standard errors of the coefficient.

[b] Dummy variable with 0 = existence of town of 5,000 population, 1 = no town as large as 5,000 population.

[c] Variable formed from the dummy variables for geographic location. 0 = not in specific geographic area; 1 = in specific geographic area. A = (Upper Peninsula—Northern Lower Michigan); B = Upper Peninsula + Northern Lower Michigan—2 Southern Michigan). For the derivation of each area coefficient, see text footnote 2.

[d] Variable formed from the dummy variables for distance from a city of 25,000 population (1960). 0 = not in specific distance class, 1 = in specific distance class. C = ($\geq$25 miles $<$50 miles) − ($\geq$50 miles), D = ($\geq$25 miles $<$50 miles) + $\geq$50 miles) − 2($<$25 miles). For derivation of each distance coefficient, see text footnote 2.

but it had lower explanatory powers, larger coefficient errors, and used more variables than the linear form. Therefore, only the linear results were used.

The basic equation (equation 1, Table 1) indicates a direct relationship between the number of hospital beds per 1,000 and capital expenditures on health and hospitals, but inverse relationships with the relative change in population, percentage of the employed labor force working outside the county, and the percentage of the population age 60 or over. The estimated number of hospital beds for a county with mean values for each variable was 3.662 per 1,000. The state average number of beds per 1,000 was 3.657 in 1965.

The relationship between capital expenditures and number of beds is self-explanatory. But the inverse relationships with the other variables are revealing. Apparently, areas with greater than average growth have not been able to increase facilities as rapidly as population increased through migration. Areas with a decreasing population, on the other hand, might have a larger relative number of beds without any expansion of facilities.

The inverse relationship between the percentage of the employed labor force working outside of the county and number of beds indicated that the number of beds per 1,000 population decreased as the percentage of "outside" workers increased. Is it possible that workers who were geographically mobile in obtaining employment were also geographically mobile in the acquisition of hospital care, so far as the relative number of beds are indicative of such care? Or are the economic forces that stimulate a higher percentage of the labor force to seek outside employment similar to those forces which may "cause" fewer hospital beds? If worker mobility is indicative of the relative mobility of the population in obtaining hospital care, the pressures from an expanding population in growth areas may be compounded.

The relative number of beds decreases as the percentage of population age 60 and over increases. It is assumed that older people need more hospital services, so this inverse relationship is unfortunate. In Michigan, the rural counties generally have a greater proportion of older population; and, given the usual assumption that rural areas have fewer hospital facilities, the results are consistent.

Dummy Variables

The results (with the exception of population change) are consistent with the assumption that rural areas have fewer beds than urban areas. However, the degree of rurality in terms of population and geographic location alters this assumption. A larger town located in an isolated area may provide hospital facilities for residents in contiguous counties. Therefore, the number of hospital beds per 1,000 population in such a county may exceed those found in rural counties without such a town. Dummy variables measuring "degree of rurality" were developed: (1) a town as large as 5,000 population located within the county; (2) geographic location—Upper Peninsula (UP), Northern Lower Michigan (NLM), Southern Michigan (SM); (3) distance from a city of 25,000—less than 25 miles, between 25 and 49 miles, and 50 miles or more.[2]

The signs of the variables already discussed did not change when the dummy variables were included in the model (equations 2-4, Table 1). Using equation 2, with no town in the county as large as 5,000 population, the estimated number of hospital beds for a typical county would decrease by 26 percent.

With all variables in equation 3, except the dummy variables, at their means, the estimated number of general hospital beds per 1,000 population for counties with a town as large as 5,000 were: UP, 4.5; NLM, 5.0; SM, 3.6. When no town as large as 5,000 was present, the estimated number of beds for each area decreased by approximately 1.5. In equation 4, the estimated number of hospital beds per 1,000 for a county with a town larger than 5,000 population increases with distance from a city of 25,000: less than 25 miles, 3.5; 25 miles but less than 50 miles, 4.3; 50 miles or more, 4.6. With no town as large as 5,000 in the country, the estimated number of beds for each decreased by approximately 1.3.

Relaxing the *ceteris paribus* assumption for a town of 5,000 population, a different hierachy appears. Ninety percent of the counties within 25 miles of a city of 25,000 had a town as large as 5,000. Fewer than one-half of the counties more than 50 miles from a city of 25,000 population had a town as large as 5,000. If one compares the estimated 3.5 beds per 1,000 population in counties with a town of 5,000 and less than 25 miles from a city with the estimated number of counties without a town of 5,000 and 25 to 49 miles (3.0 beds) or more than 50 miles (3.3 beds) from a city, the results parallel the usual assumption.[3] These "typical" counties show fewer facilities in rural areas.[4]

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[2] The formats for both the geographic and distance variables are illustrated in footnotes 4 and 5, Table 1. The values of the (0, 1) variable were derived for each county by inserting a value of unity for the appropriate class and zero for the remaining classes. For example, the amount that is either added to or subtracted from the constant term for each geographic characteristic (equation 3, Table 1), is derived as follows: Upper Peninsula $= (-.273) + (.360)$; Northern Lower Michigan $= -(-.273) + (.360)$; Southern Lower Michigan $= -2(.360)$. The Upper Peninsula of Michigan is quite rural; southern Michigan is the most urban. The distance variables are derived from equation 4 in the same manner. For other uses and more detailed explanation of this method, see [1, pp. 34–36, 72–75].

[3] Similar results were obtained for the geographic variables (UP, NLM, SM) differences when the ceteris paribus assumption for a town of 5,000 was relaxed. However, rural areas having a town as large as 5,000 had considerably greater bed availability than those without a town of 5,000.

[4] Public hospital beds previously excluded would establish a downward bias in the availability of overall hospital beds per 1,000 population in urbanized areas. The deletion also established a downward bias for the coefficient related to town of 5,000 population, as all but one of the special care facilities were located in such a county.

The results for distance are expected if one assumes an area is more likely to furnish its own facilities the greater the distance to a relatively large city. These findings indicate the usual hypothesis that rural areas have fewer hospital beds relative to population than urban areas is too simple. It appears that there are more general hospital beds available per 1,000 the greater the distance a particular county is from a city of 25,000.

The result of this study shows that adjustments need to be made for counties having a city of 5,000 or more population. These counties have more hospital beds per 1,000 population than counties adjacent to cities of 25,000 population or to other more rural counties.

Conclusion

The usual assumption that rural areas have fewer general hospital facilities than urban areas needs to be modified. Accounting for discrete characteristics featuring degrees of rurality, the general assumption does not hold. Rural counties with a town of 5,000 would be expected to have more, rather than less, general hospital beds per 1,000 population than its urban counterpart with identical characteristics. This holds regardless of whether one measures rurality on the basis of geographic location or distance from a city of 25,000 population.

If these results hold for other states as well, important modifications need to be made in the general observation that service levels are poorer in rural areas. Rural counties with a town of 5,000 or more may actually have better service levels. This conclusion assumes, as do most such studies, that quantity is synonymous with quality.

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[1] CHAPPELLE, DANIEL E., *Financial Maturity Of Eastern White Pine In New York State,* Tech. Pub. 91, State University College of Forestry, Syracuse University, 1966.

Local School Expenditures and Educational Quality: A Correlation Analysis*

THOMAS F. STINSON AND EDWARD F. KRAHMER

A MAJOR factor contributing to the viability of any community is the quality of its educational system. This factor takes on an added dimension in rural areas because many of today's national social problems are thought to be due to the inadequate elementary and secondary education provided to residents of rural areas. Urban problems have been compounded by the migration of poorly educated workers from rural America. And, at the same time, efforts to develop rural economies and reverse the population flow are often hindered by low quality schools. To compound the problems, as rural communities have declined the resources necessary for providing adequate education to the remaining residents have diminished and the quality of the school system has continued to deteriorate.

Because of its importance, there has been considerable research done on ways to measure and improve education. Many have focused on the field of educational finance, assuming that the amount a school district spends has a very strong impact on the quality of the local school system. Benchmark surveys have been made showing national or regional differences in spending for education. Attempts have also been made to determine which social and economic characteristics are associated with increased levels of spending for education, such as those of Miner [2] and Shapiro [4]. Finally, there have been attempts to determine whether economies of scale exist for education, and if they do, to determine the optimum size school. Both Hansen [1] and Riew [3] have completed this type of study.

A major problem facing all research in this field has been obtaining an adequate measure of the quality of the local educational system. Usually researchers have been forced to assume that per capita or per pupil expenditures bear some direct relationship to education quality and to continue their research on that assumption. There has, however, been almost no testing of the hypothesis that expenditure per pupil or expenditure per capita is a useful and accurate measure of the quality of education.

This paper reports the results of a test of the assumption that per pupil expenditure bears a significant relationship to educational quality. In addition, the relationships between several alternative measures of expenditure and educational quality were examined.

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* The views expressed are those of the authors and do not necessarily represent those of the Economic Development Division of the Economic Research Service, USDA, or the University of North Dakota.

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Procedure

The Iowa Test of Educational Development, a standardized educational achievement test, was given in more than 80 percent of North Dakota's school districts during 1965 as part of a statewide survey of education. At the same time, extensive educational finance data were collected from each school district. The availability of this data made a test of the correlation between expenditures and achievement test scores possible.

Twenty-four separate expenditure variables were correlated with composite achievement scores for 9th graders, 11th graders, and for the combined 9th and 11th grades to determine which measures of expenditure were related to educational quality. The expenditure variables used were in the form of a fraction, with six possible numerators and four different denominators. The numerators were: (1) instructional cost, which included only expenditures for salary of teaching and custodial personnel, textbooks, audio-visual aids, teaching supplies, and other expenditures relating directly to instruction; (2) operating cost less transportation, which included (1) plus school health expenditure, as well as other operating expenditure not directly connected with instruction; (3) operating cost, which included (2) plus transportation costs; (4) total operating cost, which included (3) plus outgoing transfer payment;[1] (5) total operating cost less transportation cost; and (6) total cost, which included all costs, both current and capital, for the school district.

The denominators used were: (1) the number of students enrolled in the district; (2) a revised number of students obtained by weighting high school students by 1.25, to adjust for the greater cost of educating high school students; (3) the number of teachers; (4) a revised number of teachers, obtained by weighting the number of high school teachers by 1.25.

The last two denominators were used to test the hypothesis that the relevant variable is the amount of resources brought to bear on a classroom unit rather than on an individual student. These denominators reduce distortions caused by small differences in student-teacher ratios that do not provide increases in quality. This is especially important in rural areas where small class sizes may force per pupil costs above the national average without providing an average quality education.

The per teacher measure also fits well with current educational theories about what factors contribute to the quality of the educational system. The largest portion of per teacher expenditure goes for the teacher's salary, an item that reflects both the experience and the education of the teacher. The residual reflects the books, audio-visual materials, and other teaching aids which each teacher has to work with.

Product moment correlations were computed for each of four size

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[1] At present, this is the best figure that can be obtained from the Census of Governments, the only consistent set of national figures.

Table 1. Correlation between various measures of expenditure and composite score on the Iowa Test of Educational Development, by size of high school, rural high schools in North Dakota, 1966

Measure of expenditure[a]	Size of high school								
	100–199 Pupils[b]			200–400 Pupils[c]			100–400 Pupils[d]		
	Grade			Grade			Grade		
	9	11	9 and 11	9	11	9 and 11	9	11	9 and 11
Per pupil:									
Instructional cost	.143	.068	.087	.098	.163	.184	.108	.063	.070
Operating cost less transportation	.113	.058	.058	.097	.020	.168	.091	.055	.052
Operating cost	−.102	−.210	−.213	−.024	.010	−.021	−.106	−.195	−.192
Total operating cost	−.106	−.215	−.219	−.017	.154	−.055	−.100	−.184	−.181
Total operating cost less transportation	.106	.051	.050	.094	.037	.158	.090	.060	.054
Total cost	.070	−.177	−.200	.013	.035	.033	.077	.156	.016
Per pupil (revised):									
Instructional cost	.169	.104	.090	.128	.225	.185	.130	.088	.031
Operating cost less transportation	.138	.093	.059	.125	.195	.169	.111	.079	.045
Operating cost	−.080	−.180	−.200	.004	.011	−.021	.086	−.173	−.199
Total operating cost	−.085	−.186	−.210	.009	.015	.009	−.081	−.163	−.188
Total operating cost less transportation	.131	.086	−.050	.120	.183	.158	.111	.083	−.044
Total cost	.055	−.149	−.020	.038	.064	.043	−.058	−.136	−.176
Per teacher:									
Instructional cost	.325**	.259*	.304**	.207	.389**	.357*	.297**	.293**	.337**
Operating cost less transportation	.306**	.261*	.326**	.204	.352*	.339*	.286**	.292**	.310**
Operating cost	.071	−.038	.021	.043	.108	.096	.055	.007	.035
Total operating cost	.065	.044	.014	.045	.106	.094	.056	.001	.019
Total operating cost less transportation	.302**	.256*	.283*	.197	.333*	.394**	.284**	.294**	.343**
Total cost	.097	.007	.105	.084	.165	.184	.082	.023	.051
Per teacher (revised):									
Instructional cost	.335**	.287*	.306**	.236	.406**	.357*	.309**	.315**	.310**
Operating cost less transportation	.316**	.289*	.309**	.234	.374*	.340*	.298**	.314**	.284**
Operating cost	.078	−.016	.021	.078	.140	.096	.069	.016	.036
Total operating cost	.072	−.022	.015	.077	.136	.095	.070	.022	.029
Total operating cost less transportation	.312**	.285*	.283*	.223	.352*	.394**	.295**	.314**	.354**
Total cost	.103	.014	.103	.114	.192	.184	.094	.044	.093

* Significant at .10 level.

** Significant at .05 level.

[a] For definitions, see text.

[b] $N=41$

[c] $N=25$

[d] $N=66$

groups of high schools, measured by enrollment: less than 100, between 100 and 200, between 200 and 400, and those between 100 and 400. Although no significant results were obtained for districts with high school enrollments of less than 100 students, statistically significant correlations were obtained for both 9th and 11th graders for districts with high schools with 100-200, 200-400, and 100-400 pupils.

Findings

Detailed results of the study are shown in Table 1. The most important findings appear to be these:

(1) A statistically significant correlation exists between some measures of per teacher expenditure and composite pupil achievement test scores. In order of their apparent significance, the three most useful measures are instructional cost, operating cost less transportation, and total cost less transportation. This correlation appears consistent among grades and among different sizes of high schools.

(2) No statistically significant relationships exist between any measure of per pupil or revised pupil spending and achievement test scores.

(3) If transportation costs are not separated from operating costs, no significant correlations exist between expenditures and achievement test scores.

Conclusion

This study does not provide the answer to the question of how to improve rural schools. Much study and research remains before any such answer can be obtained. Its findings do suggest, however, a new approach for both research and operating programs concerned with small rural school districts. It appears that the total funds available for use in a classroom unit, rather than the funds used per pupil, is the significant variable for studies of educational finance.

These results, if applicable on a national basis, suggest changes in the orientation of operating programs and future research. State aid programs designed to bring poorer school districts up to a minimum level of per pupil expenditure appear to be open to criticism. It appears that a program designed to provide a minimum level of per teacher expenditure, while keeping the pupil-teacher ratio within acceptable limits, might be more successful in improving the quality of education in those districts.

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The Farm Poor: Counted, Miscounted, or Discounted?

O. Wendell Holmes

Charles Dickens, in *A Tale of Two Cities*, opens with the statement, "It was in the best of times, it was in the worst of times, . . . it was the spring of hope, it was the winter of despair. . . ." This perhaps echoes the sentiment of many people in the United States today. Our economy is in the best of times for many but in the worst of times for others. For some, their economic position puts them in a real spring of hope. For others, their future appears as a winter of despair.

In order to more equitably share the wealth of our nation with its less affluent citizens, guidelines are needed to determine who the less affluent are, what constitutes poverty, and what some attributes of the poor are.

Lack of financial resources is the handiest explanation of poverty. The current definition has been built around income: How much is necessary to maintain a family of four persons at a given level of living. This definition of poverty was developed for use by the Council of Economic Advisers in the President's war on poverty. Later the Social Security Administration (SSA) developed a poverty line centering around $3,000. In this definition, a family of four was considered "poor" if their total annual cash income was less than $3,000; a single unrelated individual, if his annual income was less than $1,500 [4]. The SSA refined this definition by including such variables as family composition, sex of head, and place of residence, (farm or nonfarm). The resulting poverty index is the officially adopted poverty definition of the Council of Economic Advisers and the Office of Economic Opportunity.

In 1955 the Household Food Consumption Survey indicated that families of four persons, regardless of income level or place of residence, spent about one-third of their annual income on food. It was thus assumed that an income of at least three times the cost of the economy food plan was necessary to keep a family out of poverty. Using the economy food plan, as developed by the USDA, and a multiplier of "3," as obtained from the 1955 survey, a poverty cutoff level was established. Thus, if the food plan was priced at $1,000, the resulting income would be $3,000. Any family of four with an income of less than $3,000, spending $1,000 or more for food would be considered to be in poverty.

This same survey showed that about 40 percent of food consumed by farm families was produced at home. This means that the average farm

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family would produce about $400 worth of the $1,000 total food budget, and hence need 40 percent less cash for their food expenses. The food budget for farm families was thus determined to be $1,000 minus $400, or $600. This $600 figure was then used as the cost of the food plan and was tripled to get a farm family poverty income level of $1,800. For nonfarmers the poverty income level was $3,000.

Data from the 1961 food consumption survey showed that home production of food items by farm families had decreased to about 30 percent of their food needs, in dollar value. The poverty line for farm families was then adjusted to take this into consideration. Using the same food plan as before as an example, the new food budget for farm families was $1,000 minus $300, or $700. This $700 food budget was then multiplied by 3 to give a farm poverty income cutoff of $2,100. This is the 70 percent poverty level. The cutoff for an urban family was the same as before, $3,000.

A number of weaknesses in the method employed in determining the farm poverty cutoffs seem obvious. The food plan used here was designed by the USDA using data from the National Research Council for temporary or emergency use when funds are low [5]. There is no provision for improving the diet of the poor in this food plan.

The main weakness is the manner in which this method tends to discriminate against the farm poor. Because of the assumed ability of a farm family to produce 30 percent of their food (in dollar value) it was incorrectly assumed that a farm family needed only 70 percent as much income as a nonfarm family. Currently the food plan for a family of four is valued at about $1,100. The value of home produced food (in this case $330) is then subtracted from the cost of the food plan. The result, $770, is then tripled giving $2,310 as the poverty threshold cutoff level for farm families. What started out to be a $330 deduction, because of the benefits of home produced food, ended up as a $990 deduction from the farmers income, or an implicit assumption that the farmer produced 90 percent of his food needs.

The current food budget of $1,100 needs to be changed to account for recent increases in the cost of food. The current (1969) cost of the minimal nutrition diet for a family of four is now computed to be $1,284 per year. Using the multiplier of "3" on this figure would raise the poverty cutoff to $3,852 [1, p. 290].

As mentioned earlier, using the 70 percent level tends to discriminate against the poor in that many are declared to be out of poverty by definition only. However, the people not counted at the 70 percent level (but included at higher levels) are just as poor as ever. Because they are excluded from the poverty rolls means there are by definition fewer rural people in poverty. With fewer rural people on the poverty rolls and with their scattered residence, they are hard to identify. They are virtually without the experienced leadership or organization necessary to give them the voice or vote they need to gain either national recognition or political bargaining power. Thus, the number of programs and funds earmarked for the rural poor may not be as large proportionally as it is for the urban poor. In 1965, only 18 percent of the Community Action Program (CAP) grants went to the rural area programs. This increased in 1966 to 25 percent and in 1968 to 30 percent. While the percentage of CAP grants going to rural areas has been increasing, it is still low considering that 43 percent of the nation's poor are rural residents [2].

The differential, as currently used, discriminates against rural children and youths, the target groups who should receive the greatest assistance. Since eligibility for programs such as Upward Bound, Headstart, and Family Planning is contingent on being in poverty, many farm families are denied such programs since they have been defined out of poverty.

To assume that farmers need only 70 percent as much cash income as urban families is incorrect. Comparable living standards in the country would probably cost as much as in the city. Frequently the assumption is made that rural living is much cheaper than urban living. That assumption is valid only if one assumes that a lower standard of living is appropriate in rural areas [3]. In 1961, for example, among families with less than $3,000 annual income, farm families whose average annual income was nearly $700 less than that of urban families spent nearly the same dollar amount for transportation and nearly seven percent more of their income on transportation. Farm families often pay larger shares of medical expense out of pocket, while nonfarm families may profit from fringe benefits such as medical insurance and other advantages offered as part of their employment.

Because of the less developed infrastructure where the low income population is likely to be concentrated, other costs may significantly influence their lives and outlook. Among these other costs are: inadequate educational institutions, poor housing, and the complex of factors related to it, such as plumbing, lighting, fuel and heat. A lack of community institutions, or social and physical access to them, constitutes both direct and indirect costs which contribute to the general cultural milieu of poverty linked conditions.

Data from the 1967 Current Population Survey of 1966 Income shows clearly the effect of various percentage differentials on the number of persons who will be defined into poverty. Using the 70 percent level, the total number of persons in poverty, both farm and nonfarm, in 1966 was 29.9 million. The President's National Advisory Commission on Rural Poverty in its report, *The People Left Behind*, estimated that shifting the differential from 30 to 15 percent would include an additional 700,000 rural people in poverty. Analysis of the 1967 CPS data shows this to be true.

Propensities to Invest in Schooling in the South and Non-South*

Fred Hines

SUBSTANTIAL differences exist between the South[1] and non-South in public schooling expenditures per pupil. One issue of concern is whether the difference arises only from lower income in the South or whether the South also invests less than the non-South in formal schooling out of a given income. Other issues of interest are whether states with a higher proportion of rural or of nonwhite populations have a lower willingness to invest in education, other things equal, and whether federal programs to finance education distribute funds among states progressively or regressively. These issues are examined in this article.

The null hypotheses are that (a) the propensities to invest in formal schooling out of a given income are equal in the South and non-South; (b) racial composition does influence per pupil schooling expenditures; (c) urbanization does not influence per pupil schooling expenditures; and (d) federal assistance to education is distributed regressively; i.e., it rises with state income.

These null hypotheses are tested with multiple regression analysis, using cross-sectional data for the school year 1967–68 from the 48 coterminous states. Current expenditures per pupil in average daily attendance in elementary and secondary schools are used as the level of expenditures for schooling. Per capita personal income in 1967 is used as the measure of the ability to finance elementary and secondary schooling. Schooling expenditures in 1967–68, per capita income in 1967, and data on the percentage of school revenue received from federal, state, and local sources are taken from the *Digest of Educational Statistics, 1968*. Since data on percent nonwhite and percent urban are not readily available for 1967, census data for 1960 are used for these two variables.

Measuring the Level of Schooling Expenditures

Equations (1), (2), and (3) relate the level of current expenditures per student from state and local sources only (Y_1), from federal sources

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* The author is indebted to J. Martin Redfern and Luther Tweeten for much of the initial thought and work that led to this research effort.

[1] The South consists of those states within the U. S. Census' Southern Region and includes: Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas.

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only (Y_2), and from all sources (Y_3) to percent nonwhite (X_1), percent urban (X_2), per capita income in the non-South (X_3), per capita income in the South (X_4), and a dummy variable for New York and Louisiana (X_5). The dummy variable was included for New York and Louisiana because those states appeared to invest substantially more in education than other states, other things being equal. Computed t values are in parenthesis below the coefficients. The double asterisk denotes significance at the .01 level; a single asterisk denotes significance at the .05 level but not at the .01 level. The equations are:

$$(1)\quad Y_1 = 92.47 - \underset{(2.00)^{**}}{2.45(X_1)} + \underset{(.69)}{.59(X_2)} + \underset{(5.26)^{**}}{.15(X_3)} + \underset{(4.71)^{**}}{.14(X_4)} + \underset{(5.18)^{**}}{219.56(X_5)}$$

$$R^2 = .81$$

$$(2)\quad Y_2 = 119.36 - \underset{(.78)}{.23(X_1)} + \underset{(2.11)^{**}}{.44(X_2)} - \underset{(4.69)^{**}}{.032(X_3)} - \underset{(3.85)^{**}}{.028(X_4)} - \underset{(.57)}{5.87(X_5)}$$

$$R^2 = .53$$

$$(3)\quad Y_3 = 211.82 - \underset{(2.08)^{**}}{2.68(X_1)} + \underset{(1.14)}{1.03(X_2)} + \underset{(3.90)^{**}}{.12(X_3)} + \underset{(3.58)^{**}}{.11(X_4)}$$

$$+ \underset{(4.78)^{**}}{213.67(X_5)}$$

$$R^2 = .76$$

Equation (1) shows that: (a) the level of per capita income (indicating the ability to invest in education) is the prime variable in determining the level of state and local schooling expenditures; (b) the insignificant difference between b_3 and b_4 suggests that the responsiveness to an increase in per capita income in the non-South is not significantly greater than in the South; (c) a percentage increase in the nonwhite population, holding other variables constant, has a significant negative effect on the level of schooling expenditures; and (d) increases in urbanization have an insignificant positive effect on the level of schooling expenditures from state and local sources.

The coefficients of equation (2) indicate that federal support for education falls, although insignificantly, as the percentage of nonwhite residents increases; falls significantly as state income increases; and rises significantly as the degree of urbanization increases. The results do not support the hypothesis that federal funds are regressively distributed. In fact, the negative coefficients of the income variables indicate a progressive distribution of federal aid in school financing.

Expenditures per student from local, state, and federal sources are regressed on variables X_1 to X_5 in equation (3). Inclusion of federal with state and local expenditures has a dampening effect, making school expenditures less sensitive to per capita income. On the other hand, federal assistance appears to accentuate the effects of racial composition and rurality. Equation (3) again highlights the overriding importance of income in explaining schooling expenditures. The coefficients of X_3 and X_4 taken literally mean that a $100 increase in per capita income is associated with an $11 increase in per pupil schooling expenditures in the South and $12 in the non-South. However, since the difference in the coefficients of X_3 and X_4 is not statistically significant, we are unable to reject the hypothesis that the propensities to invest in schools are the same in the South and non-South. Thus, the difference in schooling expenditures in 1967–68 in the South and non-South can be largely attributed to the difference in the ability to finance schooling, as indicated by the difference in per capita income.

A comparison of the coefficients of equations (1), (2), and (3) suggests that federal funds for education are progressive with respect to income, percent urban, but are regressive with respect to percent nonwhite. As per capita income increases, state and local funds for education increase significantly and federal funds decrease significantly. As the percent nonwhite increases, state and local funds as well as federal funds tend to diminish. And as the percentage of urban people increase, holding income constant, schooling funds from all sources tend to increase.

Measuring the Public Effort in Financing Schooling

The propensity to invest in schooling, an expression of public support, is measured by the proportion of a state's personal income spent in financing schooling. Equation (4) relates this propensity index based on current elementary and secondary schooling expenditures from all sources (Y_4) to the percent nonwhite (X_1), percent urban (X_2), non-South per capita income (X_3), per capita income in the South (X_4), and the dummy variable for New York and Louisiana (X_5). The equation is:

$$\text{(4)}\quad \begin{array}{l} Y_4 = 8.09 - .021(X_1) + .008(X_2) - .001(X_3) - .001(X_4) + .84(X_5) \\ \qquad\qquad\quad (1.23) \qquad\quad (.64) \qquad\quad (2.61)^{**} \quad\; (2.59)^{**} \quad\; (1.42) \\ \hfill R^2 = .21 \end{array}$$

Equation (4) indicates that in 1967–68 the propensity to invest in schooling (as denoted by the percentage of total personal income spent on elementary and secondary schooling) decreased significantly with higher per capita income levels. Also, the effect of the income level on the propensity to invest in schooling is not different between the South and non-South as indicated by the insignificant difference between the coefficients of the respective income variables in equation (4). Neither the coefficient of the percent urban nor the percent nonwhite variable is statistically significant in equation (4), indicating that when income is held constant these variables have no significant effect on a state's propensity to invest in schooling.

Summary

Results reported herein give no basis to reject the following null hypotheses: (a) that the propensity to invest in schooling is the same in the South and the non-South, and (b) that racial composition does influence per pupil schooling expenditures. However, there is evidence to reject these null hypotheses: (c) that urbanization does not influence per pupil schooling expenditures, and (d) that federal funds for schooling are distributed regressively among states. Although urbanization does not influence schooling expenditures from state and local sources, it does have a significant positive effect on the level of schooling expenditures from federal sources. Addition of federal funds to local and state funds tends to dampen the influence of income on schooling expenditures and results in a more even distribution of expenditures per student among states, according to this analysis.

It is quite true that the southern states spend less than non-southern states on schooling per student. But the difference is explained largely by the relative ability to finance schooling, as measured by income per capita. After adjusting for the ability to invest in education, as indicated by per capita income levels, there is no significant difference between the schooling investment in the South versus the non-South.

VIGNETTES: TEACHING, CURRICULUM, RESEARCH

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A View from the Middle Ground*

O. RICHARD MORRIS

PERHAPS doctoral students have too narrow a view of a doctoral program and the dissertation requirement imposed upon them; hence, they are too often dissatisfied and apathetic. Frequently candidates complain they are unjustly treated relative to the phrase "partial fulfillment of the requirements" appearing on the title page of their dissertations. The platitude, "the best thesis is the one that gets you your degree," reflects an underlying apathy. Others simply regret time spent writing their dissertations. A brief discussion of the rationalist tradition and a theory of knowledge, including how knowledge grows, may help motivate doctoral candidates by providing some understanding of professional scholarship as well as some criteria for making self-evaluations.

The theory of knowledge and description of the rationalist tradition adopted in this paper have been proposed by Sir Karl Popper [1, 2, 3]. Popper suggests that tradition is the intermediary between people and impersonal social institutions [1, p. 134]. He views a tradition as a way to describe "a uniformity of people's attitudes, or a way of behavior, or aims or values, or tastes" [1, p. 133]. The norms, rules, and laws that prohibit people from using unacceptable means to attain their desired goals and objectives in Popper's view of a social institution [3, vol. 1, p. 59].

The rationalist tradition—traceable to the pre-Socratic Ionian school of Thales and Anaximander [1, pp. 136–165]—is recognizable, first, by the critical attitude that perhaps things are not yet perfect; secondly, by their regarding ideas and criticisms separately and irrespective of their proponents; and thirdly, by the generally accepted belief that ideas and criticisms are more fruitfully discussed with a minimum of emotion and passion. But what does a rationalist gain by adhering to such negative attitudes and beliefs?

Popper proposes that knowledge is a product of criticism. "We learn from our mistakes" more than from our successes. By showing that certain

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truth is impossible to attain [2], Popper rejects the traditional pursuit of truth and knowledge as proper objectives for science and philosophy [1, pp. 3–30, especially pp. 24–25]. He proposes instead that the task of scholars and scientists be the revelation and elimination of the erroneous and the mistaken solutions to our problems [1, p. 25]. In this sense, Popper's concept of knowledge is quite negative, since we can learn only what is false, but it does not prohibit scholarly progress if we are willing to examine critically the proposed solutions to our problems.

To rational argument and discussion, his theory assigns "the role of criticism of our attempts to solve our problems"; while to our observation, his theory assigns "the equally important role of testing these solutions." Our knowledge progresses by "unjustified (and unjustifiable) anticipations, by guesses, by tentative solutions to our problems"; by what Popper calls "conjectures." "These conjectures are controlled by criticisms; that is, by attempted refutations, which include severely critical tests. . . . Criticism of our conjectures is of decisive importance, since by examining our mistakes and failures we understand the inherent difficulties of our problem" [1, p. vii]. Thus the answer to the preceding question is: A rationalist can learn and he can progress.

From these brief excerpts of Popper's ideas, it is clear that a rationalist tradition is necessary for knowledge to grow. If criticism is absent, mistakes would not be uncovered; hence, there would not be any learning opportunities. Also, criticism is the generator of new problems to solve, which are themselves a necessary input to produce knowledge and a necessary condition for the survival of functioning universities. To minimize sincere and honest criticism would, and does, in effect minimize the opportunities to learn, the growth of knowledge, and the raison d'être of universities.

The preceding discussion provides a framework for proposing criteria to judge a doctoral candidate and his dissertation. The following criteria for the candidate and the criterion for his thesis are consistent with Popper's theory of knowledge and are necessary if the rationalist tradition is to survive fruitfully in a scholarly profession.

Criteria for Candidate

1. The candidate should recognize his and others' mistakes as opportunities to learn.
2. The candidate should be capable of critically analyzing and rationally discussing previous attempts to solve a particular set of problems.
3. The candidate should have a genuine interest in knowledge.

The first two proposed attributes insure that the candidate is critical and can provide worthy opposition to imaginative conjecturing. If a scholarly community contains individuals lacking either of these attributes, "grain-chaff" problems are intensified for the serious scholar. He must spend extra time and resources separating the investigations conducted by other serious scholars (i.e., the grain) from those investigations conducted by those who lack the proposed attribute (chaff). Also, all members of the community need worthy opposition to control imaginative conjecturing and to insure that learning opportunities continue to arise. No benefits accrue to anyone when errors go undetected. These problems and undetected errors not only reduce individual efficiency, but the total efficiency of the community as well. Furthermore, resources must be reallocated to solve these problems and others they may cause.

The third proposed attribute insures that the candidate is serious in his criticism of others and accepts others' criticism with sincerity. In a community where some members neither offer nor accept criticism as an opportunity to learn, criticism may become viewed as retributive or slanderous. Again the serious scholar is faced with the problem of determining whose criticism is petty or sinister and whose is honest and sincere.

The criteria are only suggestions to minimize possible perversion of a rationalist tradition within a profession. It is impossible to completely eliminate all opportunities for perversion because of the uncertainty of future events, and any attempt to do so would be a revival of the Inquisition, which was itself incompatible with bold imaginative conjecturing. A feasible alternative, however, is to impose a requirement that all new members have the proposed attributes. In the uncertain situation of the candidate's final oral examination, the most that his committee can assert by a favorable recommendation is that the evidence does not refute the conjecture that the candidate is qualified.

However, the proposed individual attributes have their limitations and frailties. They should not be viewed as sufficient conditions, but only as necessary conditions for maintaining a strong, fruitful rationalist tradition within the scholarly community. Because of the uncertainties and incompatibilities mentioned above, necessary and sufficient conditions are impossible to propose.

The proposed criteria for doctoral candidates allow certifying a broad range of scholarly talent, yet they make specific lines of demarcation. The criteria permit certifying students who lack imagination to solve problems, but only when they are capable of providing the critical scrutiny needed to control imaginative conjecturing. At the other extreme, certification of imaginative candidates is limited by the criteria to those who realize the importance of criticism and who respect critics and their contributions.

Criterion for Dissertation

The proposed criterion for judging the candidate's thesis is that it should provide corroborating evidence that the candidate possesses the above-mentioned attributes.

The proposed thesis criterion contains no specifications or qualifications for the candidate's conclusions, findings, or reports. A priori conditions on potential findings or conclusions would (1) place the candidate in a situation where compromise of intellectual integrity may be an expedient means of attaining his degree, or (2) require the candidate to conduct several legitimate investigations until he found one satisfying the preconditions. A precondition may be impossible to satisfy if a desired foregone conclusion is, in fact, false. The proposed thesis criterion only reiterates that the candidate's critical capabilities be considered foremost.

However, a major question is still left unanalyzed: What considerations should be made to judge whether the proposed thesis criterion is satisfied? To assess the candidate's appreciation of errors, it is suggested that the various research decisions he made during his thesis investigations be examined to see if he selected analytic methods that are likely to reveal his or others' errors. The dissuasive content of his arguments and comments about present knowledge would indicate the candidate has critical capabilities. Questions to the effect—Do his conceptualizations and comments reveal problems which the present knowledge is incapable of posing or solving?—would provide a rational basis for judging the dissuasiveness of his arguments. The genuineness of a candidate's interest in knowledge would be indicated by the tests he proposes or conducts to empirically criticize and possibly refute his theories. Here the question—Are his theoretical conclusions empirically refutable by observation?—will help in evaluating the proposed tests.

What conclusions or recommendations are suggested by the preceding discussion? First, students' complaints of unjust treatment should be viewed critically by asking the question: Are the students misinterpreting honest and sincere criticism as unjust treatment, or are they receiving unjust treatment in the form of low quality criticism? Second, the platitude that the best thesis is one that gets the student his degree does not really maximize the serious students' own interests. His "best" thesis provides a sheltered opportunity to practice the critical skills he will need if he is to survive and contribute in his chosen profession. Third, from a professional view, the "value" of a doctoral degree is inversely related to the proportion of non-critical persons perverting the rationalist tradition in the corresponding profession. It is to everyone's benefit to maximize the amount of honest, sincere criticism he is capable of providing, and to maximize the total amount of legitimate criticism communicated among the members of a profession.

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At a Crossroad: Graduate Teaching in Agricultural Economics*

Curtis F. Lard and J. Rod Martin

TEACHING must be considered the most important function of a university regardless of whether it is at the undergraduate or graduate level. Therefore, the most important task of the university professor is teaching. The primary emphasis of this presentation is placed on graduate teaching in agricultural economics. The definition of graduate teaching, as used in this article, includes such functions as: formal classroom teaching; informal teaching or intellectual discussions; conducting seminars; program, thesis, and research directing; and professional and personal counseling. We believe that the various departments are not giving enough attention to graduate teaching and that this is a major problem facing the profession.

The Problem

An appropriate framework for delineating the problem of graduate teaching could take the form of a hypothesis. *Graduate teaching in agricultural economics departments just happens without much planning and preparation on the part of the graduate teacher and with inadequate coordination and supervision within the departments.* We do not intend to empirically test this hypothesis in this presentation. However, a review of our professional journal indicates that many agricultural economists have been concerned about undergraduate teaching [4, 8, 9], and the graduate training of foreign students [1, 5]. The number of articles occurring in this Journal over the past 10 years is evidence of this emphasis. However, very little space has been devoted to graduate teaching in general. One could conclude from this that graduate teaching in agricultural economics is in a good state of affairs, or one might conclude that it is in such a condition that we should not mention it or else we do not care.

We cannot accept any of the above conclusions. But observation of graduate students and graduate professors in the discipline of agricultural economics indicates that we are facing some major decisions in graduate teaching. Many professors view teaching as a necessary evil to which they want to give as little time and effort as it is possible to "get by with." In addition to this, the complexity of problems in modern agriculture, the pursuit of truth, and the dissemination of information are beyond the

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[*] Texas Agr. Exp. Sta. Tech. Art. 7980.

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scope of an individual professor and must be approached through an interdisciplinary or systems orientation. This is just as relevant for graduate teaching as it is for research, which was emphasized by Shaffer [7]. This leads us to believe that graduate teaching in agricultural economics is in a critical state and *at a crossroad.*

Assessment of Good Graduate Teaching

Schultz [6] has indicated that he believes it is possible for us to apply our concept of efficiency and our analytical thinking in assessing teaching and learning. Let us assume that we can assess or evaluate our graduate teaching. From the standpoint of the department, how should this be done?

In assessing graduate teaching we must look closely at the component parts—the objective, resources, and alternatives [2]. The resources consist of the university, the academic community, the department, supporting departments, professors, graduate students, and the facilities. First, the university and the academic community must provide an environment and an atmosphere in which learning can take place. This would include such things as an adequate library, computer facilities, a concerned administration, and freedom of inquiry.

The department must provide the professors, the physical facilities, the course offerings and programs, and an intellectual environment conducive to learning. For an agricultural economics department to have an excellent graduate teaching program, its supporting departments, such as economics and statistics, must have strong programs. An obvious and essential requirement is that the departmental administration must recognize and reward good quality or excellent graduate teaching.

With respect to the professor-student relationships, the professors who teach graduate courses and advise graduate students should be viewed as learning partners with graduate students. For maximum learning and development to occur, this partnership must prevail throughout the graduate student's program. There is a tendency to equate success with the fact that students receive Ph.D's and professors advance in their profession. But this does not mean that good graduate teaching has occurred. Although there are many excellent graduate professors in this discipline, we must be aware of the fact that there are superior substitutes for almost any professor and perfect substitutes for many professors in graduate teaching programs. Proof of this is evident by the fact that several leading institutions have utilized programmed materials and computer instructions to increase effectiveness and even replace some of the teaching functions of the professors. Based upon these experiences, many see the computer as a liberator of the teacher, enabling him to spend more time on the specific needs of the student [3].

In considering the effectiveness of the teaching-learning process in our agricultural economics departments, we must take the following items into account: (1) a continuous evaluation of the total framework utilized within a department to prepare individual students to respond favorably and solve various problems that they encounter as students and as future professional agricultural economists; (2) tests to measure the increased ability of the students to use principles and techniques in problem solving situations; (3) the relative emphasis placed on specifics as contrasted with principles and theories in graduate teaching; (4) the general relationship that prevails between the student and the professor; (5) continuous evaluation of graduate professors through some well-constructed means of evaluation; and (6) reviews of course content and research projects conducted by graduate professors. We believe that these assessments may be initiated and/or conducted by an appropriate group within each department and used by the department for the betterment of all parties involved.

A Recommendation for Improving Graduate Teaching

The major point of our recommendation for improving graduate teaching is the establishment of a graduate teaching faculty within each department. This faculty would assume the responsibility of coordinating all graduate teaching activities within the department. Establishing a graduate teaching faculty would initiate immediate action with respect to pulling together all of the loose ends that may exist in the graduate teaching program. Currently, in many departments one individual or an individual for each major field of study usually spends a major portion of his time coordinating graduate functions. This department member should probably continue in this capacity for the incoming students, but he should report to and be guided by the graduate teaching faculty.

The specific duties of the faculty could be divided into two distinct areas: (1) the current graduate program and (2) the long-run program. In improving the current program the faculty should encourage the administration of and work out specific details for the following:

1. Closer correlation of research and teaching so that ideas generated in teaching can be further developed by students and/or faculty, thereby enhancing both functions.
2. Use of a comprehensive Ph.D. examination for those students who aspire to graduate teaching or a broad examination for new teachers.
3. The employment of superior teaching techniques and/or aids, such as visual aids, computers, team teaching, and special lecturers to help lower the cost of learning or increase the value of new knowledge to the students.
4. Train teachers and students to recognize the "threshold of learning"

or "the take-off stage for learning" and to stress only the most significant concepts and techniques.

5. Replace some semester courses that are too long for sustained high rates of learning with four-week periods of concentrated study on only one or two courses concurrently.

6. Put the philosophy base back into our Ph.D. programs in agricultural economics, especially training in reasoning and the philosophy of the social sciences.

7. Give doctoral candidates who plan to teach some actual teaching experiences under the supervision of outstanding graduate professors while they are in graduate school or when they first start graduate teaching.

8. Employ in-service training programs for the teaching faculty.

9. A comprehensive evaluation of graduate teachers by examining their teaching, courses, research projects, student counseling, writings, and a periodic re-examination to determine if the professor "measures up" or is obsolete.

10. Equal compensation for good quality graduate teaching and for good (published) research.

Although not as clear cut as the immediate needs, the responsibility of the teaching faculty regarding the long-run program might be even more important than the short-run or current activities. This is particularly true with respect to the matter of developing and maintaining *leading* departments. One obvious area that should receive attention is developing computer-assisted, computer-managed instruction and programmed materials to be used in the agricultural economics departments. The future use of these techniques is inevitable as a result of their effectiveness. An individual professor cannot be as effective as a team of experts because we can be assured that students will be exposed to a "core" of theory and problem solving techniques when programmed or computerized courses are developed by a qualified team from the graduate teaching faculty. This approach may also be the best way to develop an individual's learning and problem solving ability. The "liberated" professors may have more time for research activities which would update their teaching. The importance of this area is such that each department should allocate one qualified staff member, full time, to the study and utilization of these new teaching techniques. This staff member would work closely with and report to the graduate teaching faculty.

Establishing graduate teaching faculties to administer teaching functions could be the most effective way of upgrading graduate teaching in agricultural economics. Most departments have the collective ability in terms of teaching staff to develop excellent programs. The faculty could be effective in terms of coordinating, assessing, and improving their own activities. By its very existence, the faculty would have influence on the department chairman and the dean. But the most important aspect is that in the administration of the best possible program, the graduate teachers would have to face up to their real responsibilities!

In concluding, we challenge the American Agricultural Economics Association to develop an award program for graduate teaching in agricultural economics comparable to the current undergraduate teaching award.

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Institution Building: Training Gap in Economic and Agricultural Development*

HAROLD D. GUITHER

TECHNICAL and development assistance programs of the U.S. government, private foundations, and universities have operated on the premise that "the most effective and enduring contribution to human resource development is through the building of indigenous educational institutions which will enable a nation to help itself by educating its own people to enter and sustain themselves in the modern world" [5].

Study and training for foreign participants have been financed by the USAID, AID-university contracts, private foundations, and home governments. Although U.S. training is considered a means to develop subject matter competence, many do not teach or carry on research when they return home. A survey report of AID participants stated, "One can discern a net loss from the ranks of professionals and subprofessionals and a net gain in the administrative and managerial categories" [3, p. 158]. A returned student needs additional tools or capabilities to lead and administer a new or remodeled institution to further his country's development. However, only a few agricultural economists have pointed out the need for training in administrative principles and practices [4, 6].

Many goals of developing nations can often be achieved only through an organized institution [2]. A study of rural development assistance contracts concluded, "Training in leadership and administration should be an integral part of many participant programs and AID and the universities should develop cooperatively concentrated post-degree short courses to meet this need" [1, p. 21].

Areas of Training

Areas of training for leaders and administrators in agricultural institutions are listed below. Although this discussion of institution building emphasizes educational institutions such as universities with teaching, research, and extension programs, the same concepts and principles could also apply to other institutions engaged in credit, marketing, information, planning, or cooperative activities.

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Historical perspective and concepts

The agricultural institutions of developed countries offer ideas and motivations for those from developing countries. Changes, however, should fit local cultural, economic, social and political values. Study should include: the concept of institution building and relationships to agricultural and economic development; the application of institution building to the stages of a country's development; the purpose of national planning bodies and the role of agricultural institutions to facilitate development; and the relationship of national agricultural and economic policies to the developing institutions.

Organization, administration, and policy development

Study and training should include: administering the academic program, library, research station, and extension programs; maintaining physical facilities; identifying and applying appropriate and effective communication methods; using science and research to implement development, rather than treating it as an end in itself; developing new alignments between scientific disciplines to improve research, teaching, and extension; using sound business management in accounting, purchasing inputs and supplies, marketing surplus products, merchandising the capabilities of graduates; and using capital and credit to facilitate institutional development.

Personnel management

For those in responsible positions, the following should be included in a study and training program: improving administrative competence through visiting consultants, outside study by staff members, and short overseas observation visits by top administrators; orienting staff members for service and motivating them to generate public support; developing attitudes and philosophy to generate productive research and teaching programs; facilitating student achievement consistent with institutional goals; developing professional and personal attitudes among faculty scientists that contribute to success of the institution as well as prestige to the individual; developing meaningful and constructive relationships between students and faculty; sharing authority for professional decision making among faculty members and building faculty morale by clear understanding of personnel policies, appropriate working conditions, and consultation on changes of assignments.

Relationships with outside groups and agencies

Maintaining communications linkages between the governing elite and the community will permit the institution to carry out its objectives and receive continuing support. Training and study in this area should include: developing community teamwork and enlisting cooperation from outside groups; adapting the mechanisms for gaining support to the culture and environment of the developing country; developing insights into the role that farmers and local people can play as advisers and assistants in gaining public support; finding ways to use developmental assistance offered by foreign agencies, governments and international organizations in ways that will benefit the institution and meet the purposes for which such aid is offered; and taking an appropriate role as administrators in working with local government and assistance agency representatives to achieve productive returns to the developing institution.

The Role of Agricultural Economists

Rural social scientists, including agricultural economists, can play a key role in leading research and training in agricultural institution building and administration. By their training and experience they have an understanding of (1) institutions contributing to economic development; (2) principles of resource allocation to achieve optimum output; (3) efficient labor and capital use; (4) the role of borrowed capital (credit) in economic growth; and (5) the principles for efficient operation of the firm.

The agricultural economist should recognize his limitations in understanding cultural differences and sociological motivations that may overshadow economic incentives. Colleagues in public and business administration, sociology, political science, and anthropology could also contribute in the subject matter areas outlined above.

Program Alternatives

The setting for disseminating ideas on institution building could be (1) regular university courses offered for graduate credit; (2) seminars for credit or non-credit for all agricultural students from less developed countries; (3) special seminars or short courses which could be given after completion of graduate degrees just before the student returns to his home country; (4) seminars or short courses for new administrators or key leaders given either in the United States or overseas.

If some who participate in such study programs continue as teachers or research workers instead of moving into administration, their knowledge and understanding should enable them to contribute more effectively to their institution's development. If economic and agricultural development is largely human and institutional development, developing people for leadership deserves at least equal priority with developing land, buildings, crops, and livestock.

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Involvement in Undergraduate Education

MURRAY H. HAWKINS

STUDENT disinterest and teacher apathy are threatening to turn academic activity at the undergraduate level into a frustrating and meaningless experience. The professional nature of agricultural economics has tended to blunt this development, but agriculturists cannot become complacent nor deny the possibility of its imminent arrival. The striving for excellence and the increasing prestige in graduate education and research (in conjunction with the role of the agricultural economist as a consultant) have hastened the downgrading of undergraduate teaching as a vocation, and larger academic classes tend to reinforce the situation.

Student Awareness

Students instinctively recognize the growing preoccupation and indifference of some of their professors and the consequent mediocrity of instruction at the undergraduate level. The bright student looks eagerly forward to graduate school where he will finally be allowed to do his thing. The average student "kills time" until that great day when he can enter the "real" world. The below average student drifts in a state of stultified helplessness, unstimulated and unloved. More and more frequently, inquiring minds break out of this situation and vigorously protest their abandonment.

These statements are not a revelation; indeed, these reflections even cross the desks of university administrators from time to time. Yearly statements are dutifully issued to the faculty that undergraduate teaching is the primary role of the academic community. After conventional lip service has been paid to the ideal, the statements are carefully and firmly set aside at the first possibility. Staff promotion, appointments, tenure considerations, and other aspects of academic life are then evaluated on the more traditional basis.

The task

What can be done? The goal of the institution should be to totally involve the *entire* academic staff, auxiliary staff, and the undergraduate students in the learning process.

The assumption

One must assume that staff, students, and administrators are willing

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and able to involve themselves and that they have the means for doing so.[1]

The Technique of Involvement

There is no perfect solution. The techniques suggested here have been used with varying degrees of success by the author and his colleagues. Nor does this list of methods under discussion exhaust the possibilities.

The undergraduate course structure and curriculum needs reshaping with concern and ingenuity. Stereotype lectures, exams, and uninspired grading systems must give way to new approaches. Reforming and enriching the undergraduate program should assume first priority in the hierarchy of academic and quasi-academic endeavours. An attitude of total commitment should prevail in departments teaching undergraduates. Given an environment in which undergraduate instruction takes priority and in which undergraduate teaching assignments are given to staff members able to communicate with their students, it will be possible for the lecturer to begin the task of mutal involvement.

A Two-Course Core[2]

The subject matter for a core subject area in agricultural economics should be divided into at least two component parts. Typically, this division will involve two quarter or semester courses. Care must be taken in the initial course to adequately prepare the student for his adventure into in-depth participation in the second.[3]

Component one

The first component course should be of a theoretical nature and should prepare the student to plunge into the second course. This arbitrary course division would also allow non-specialists to participate at the lower course level. The procedure is somewhat like preparation in traditional undergraduate education for graduate school and differs only in that its application may occur at the second, third, or fourth year of the university program, its implementation depending on the level of prerequisites and general background material.

The first course should concern itself with an intensive lecture and reading program. However, this approach is not as traditional as it would first appear. The first requirement of this course, or for that matter any course, should be to prepare a detailed and specific course outline. The outline should include such matters as course content, general course policy outlines, grading procedures, weekly reading assignments, selected supplementary readings, quiz and midterm dates, office hours,[4] term papers, and miscellaneous course assignments. The outline should be distributed on the first day of class. It becomes, in effect, an unofficial contract between the class and the instructor. It provides a proposed plan of operation for the course that will prove invaluable in control and evaluation proceedings. In addition, the students will have a firm foundation from which to operate and (to a limited extent) from which to bargain. All course outlines should be filed with the department chairman and interested contemporaries.

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[1] Perhaps this assumption is unwise, but most economists succeed in eliminating the real problems with a selection of assumptions.

[2] The core area, within the author's area of experience, includes marketing and agribusiness management.

[3] In addition to the first course listed herein, all necessary mathematics, statistics, etc. courses should have been taken.

The reading list for undergraduates should be realistic in length and depth. Detailed and prolonged reading assignments that are developed to illustrate how "high powered" a course is, succeed only in discouraging the class and dampening the enthusiasm norm of the students. The selection of a good text plus the addition of two or three well chosen supplemental readings should prove adequate. An additional bibliography may be interesting for some students and should also be provided. In an era in which undergraduate curricula are being comprehensively overhauled, it is essential to be realistic in regard to the total number of hours available to any one course. A well chosen, short, and intensive reading list upon which the student is examined in depth would do much to reduce the credibility gap between the instructor and the students.

In larger classes or at the lecturer's discretion, class representatives should be elected to provide feedback and consultation on the course presentation and to provide suggestions for the 25 to 30 percent of the course content that would be under student advisement. In an introductory three-lectures-per-week course, two lectures should be directly the sole responsibility of the instructor. The final lecture should concern itself within the relevant subject area but should involve some additional material on subjects excluded in the course or a deeper analysis of course materials of general interest to the class. Special speakers, interested students, or the instructor himself could offer the third lecture.

Student protest has almost eliminated the "snap quiz" and irrelevant term paper. Realistically, one should not regret their demise. However, the substitution of a number of short, concise, prearranged quizzes is an excellent technique for involving the student in the course material. The use of this evaluation technique allows the elimination of the lowest quiz grade from the final tally. It is extremely difficult to be prepared for all efforts, and students note the inherent justice of this procedure. Term papers, with the growth of excellent student libraries and their collection of source materials, are becoming a less useful device in the learning process. They are difficult to evaluate, and outright plagiarism is becoming increasingly prevalent. If term papers are to be used, there is a need for ingenuity and variety of design in order to "action orientate" the material. A comprehensive, objective student evaluation should complete the first course.

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[4] An open door policy during the school term should be department policy. It is recognized that large classes and abuses of the policy may limit the universal application of this principle. However, consulting and extracurricular affairs should not impose office hours.

Component two

The second course in the two-course undergraduate presentation should be a "mini" version of graduate school. It should evolve around a balanced attack on the perception of the student and his total involvement in the subject matter.

In several areas of agricultural economics, computer games could form the basis of the course. In addition, selected case studies, field trips, debates, oral and written team presentations, and visual aids could supplement this approach. The above approaches can be abused, but properly used, they can have a considerable impact in involvement. Several recent developments are also worth mentioning. Through the use of television and video tape, class projects take on a new dimension. For example, preparation of a half-hour television presentation on an approved topic stimulates the undergraduate to give his time and interest to the project and involves him completely. Moreover, screening of the final product is a worthwhile experience for the entire class.

As a matter of policy, agricultural economics departments should develop research projects that utilize the considerable talents of their undergraduates. Supervision of their endeavours and indeed the development of the working program could be the responsibility of selected graduate students, the goal of the "mini" research experience being to involve the professor, graduate student, and undergraduate student in a coordinated effort.

Through the use of the grading system, student participation can be broadened even further. At an early stage in their careers, students should be contemporaries. Provided that preparation in the first phase of the two-course program has been adequate and that detailed grading guidelines are available, the lecturer should have few qualms in regard to sharing this onerous task.

It becomes necessary at this point to reinforce a previous point. Unless the student has been prepared adequately at an earlier stage in the educational process, the implementation of the involvement techniques will have many of the characteristics of a "mixed orgy."

General Observations and Conclusions

The challenge of maintaining a meaningful relationship between the student and his teacher has become an increasingly difficult task. Motivation becomes an intuitive feeling that can be developed only through joint involvement. Incentives to learn must be delicately integrated throughout the curriculum. Agricultural economists have stressed that bountiful production depends on the wise use of incentives in order to direct and stimulate individual entrepreneurs. The lesson has been learned well in the general policy area but not at the undergraduate teaching level. Implementation of an impersonal grading curve has effectively dampened the grade incentive in the undergraduate program. Classes are quick to establish a "bogey" or norm, and instructors are forced to live with this informal climate.

This text has attempted to outline an argument to revitalize the undergraduate teaching and learning experience. The revitalization goal will become a reality only when the academic staff, the administration, and the students develop a deep feeling of commitment and mutual involvement.

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VIGNETTES: NATURAL RESOURCES, FOREIGN TRADE, AND ECONOMIC DEVELOPMENT

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Using Local Comprehensive Planning to Control Lakewater Pollution in Seasonal Home Communities[*]

ROBERT W. SNYDER

A GROWING body of research indicates the rising economic importance of preventing lakewater pollution in second home communities. Estimated annual local cottage-user expenditures of $1,800 per unit influence many local government decisions that sharply affect summer home growth potential [3]. Lakewater pollution and over-eutrophycation resulting from lakeshore use must be controlled. How much is this going to cost and how will the total cost be allocated? What is the role of local comprehensive planning and zoning in determining answers to these questions?

Clearly, the value of comprehensive planning varies with the source of pollution. Where pollution results from aggregations of people, farming operations or industrial activity, pollution control costs should be assumed by each polluter. These costs will not affect most location decisions since they usually cannot be avoided by locating elsewhere. Each violation or potential violation warrants individual attention. Such customary preventive devices as code enforcement, regulation, inspection, and licensing can be economical and successful. Action by a state agency, if adequately financed, may be quite appropriate. Local comprehensive planning will have, at most, a relatively minor role.

Pollution traced to lakeshore residential property presents a different situation. Presumably, the incidence of cost still should rest largely on the polluter, i.e. the resident or the seasonal homeowner. But the amount of cost can be sharply affected by comprehensive planning. Lower costs will attract potential vacation home buyers. Thus, comprehensive planning can contribute to economic development.

Comprehensive planning operates well only in a dynamic setting. Seasonal home communities are growing rapidly. Nationwide, the decade of the fifties saw a 74 percent rise in census-enumerated second homes to a

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1960 total of 1,400,000 [4]. Casual observation and other indicators suggest that the trend has continued, probably accelerating, in the sixties. In Minnesota, an estimated additional 4,000 lakeshore cottages appear annually. This high growth rate has led to predictions of the incipient disappearance of available undeveloped lake frontage. Assuming a density equivalent of one hundred feet per cottage, however, if present trends continue, Minnesota's natural endowment is such that less than one-half of the total frontage is likely to be developed by 1980. As a result of rising interest in non-frontage property, even this projection may be on the high side. Ragatz has predicted that future second homes will increasingly be located in complete "planned unit developments" (PUDs) in which a limited amount of lake frontage is shared among several non-frontage cottages [2]. Other shared facilities may include golf courses, swimming pools, tennis courts, and so forth. Several PUDs have already appeared in Minnesota, as elsewhere. They are strongly competitive with cottages on individual frontage lots and will become more so as the price of frontage continues upward. This will retard the development of frontage property.

Given these facts, unless the Minnesota case is atypical, the continuation of present trends will produce a development pattern around many lakes comprising numerous separated dwellings or small clusters of dwellings, a few PUD's, some commercial recreation establishments, and public accommodations. Under these low density arrangements, probably persisting for some time, the only economically feasible way to dispose of household wastes is private on-site disposal systems. Locally controlled boards, strenuously enforcing adequate sanitation codes, can prevent lake water pollution. Comprehensive planning can contribute by identifying areas where problems are likely to occur, establishing appropriate physical development standards and providing guidelines for code formulation. To a very limited extent, "use" zoning may prevent development at some of the poorest locations.

This method for pollution control has the advantage of minimum interference with the property rights of individuals. It has the disadvantage of high cost. Inspecting and regulating large numbers of individual disposal systems will be both costly and difficult for local government. Homeowners, especially those with cabins on so-called "tight" soils or high water tables will also face high costs. If and when private disposal systems need to be replaced with a public system, homeowner costs essentially double. Many areas are well on the way through a process that will result in this multiple expense.

The alternative to on-site systems, code enforcement, and the ultimate high cost is to use comprehensive planning in a somewhat bolder context. This would require local government to exercise a significantly higher level of control over the pattern of development. Enforced orderly development could be served by public waste disposal systems from the start. These public systems, using modern technology, often are cheaper and more efficient than private systems. The lagoon system, in particular, appears to be particularly adapted to situations where disposal problems are concentrated in the summer months. Properly planned, waste collection and treatment facilities could be enlarged without excessive additional cost. Development of areas with tight soils and high water tables would not create unusual problems.

Savings on many other public services, such as roads, law enforcement, public water, and even street lights are also possible with controlled, orderly development. Reducing public service costs is important. Minnesota research results suggest that township governments in lakeshore areas lack the financial means for providing adequate access roads for all lakeshore property. Meanwhile, survey responses indicate that seasonal homeowners are highly critical of local access roads, which in Minnesota are provided by town governments.

Can Comprehensive Planning Reduce Costs?

It is common knowledge that supplying public services to a scattered residential development results in a high per unit cost. The frequently heard "pitch" of comprehensive planners operating in suburban areas keeps this fact safe from oblivion. The planners, however, also tell us that we can control development patterns through comprehensive planning. This has not, so far, proven to be a statement of very great validity. Our experience in trying to prevent urban sprawl and leapfrog residential development has said loudly and clearly that we are losing the battle. As unpalatable as it may be, the truth is that zoning and other land-use control devices, although beneficial in other ways, have been strikingly ineffective in controlling sprawl. This has been due to three basic facts of life:

1. Holders of undeveloped land, sometimes unwisely, prefer playing the game of "real estate roulette" to the unspeculative security offered by orderly developments.
2. Local government decisions regarding zoning and related matters are strongly influenced by the preferences of these landowners.
3. We have a long tradition of strong property rights and are reluctant, even where political influence is not a factor, to take away the privilege of playing "real estate roulette" under a control system that pays the landowner nothing for giving up this right.

Besides, the easily visible effects of this failure of zoning and the lack of sufficiently stringent zoning regulations, we learn from Manvel that three-fourths of all requests for zoning variances and rezoning have been approved, despite the wholly justified complaint of planners that such actions eventually destroy a large part of the value of comprehensive planning [1]. Thus, more stringent regulations may not make zoning more effective.

There is little reason to think zoning will be any more successful in rural lakes regions than in the suburbs. More likely, it will be less successful. The level of ignorance about the physical characteristics of our lakes and lakeshores is distressingly high. Until we are willing to spend large sums to dispel this ignorance, we will not be in a position to use zoning intelligently even for the limited purpose of augmenting sanitary code enforcement. The level of expenditures required to produce knowledge needed for more stringent and detailed zoning may not be acceptable.

Recognition of the problem is a first step, but an encouraging one. We are gradually learning more about our natural resources. Future zoning ordinances will reflect this greater knowledge as well as more experience with lakeshore zoning. But zoning is, and probably always will be, an imperfect tool. Where lakeshore development control is essential other more effective measures will have to be taken.

One such device is simply to install public sewerage in desirable development areas prior to actual development. Initial costs are high, with estimates running up to and beyond $20 per foot of frontage. They would probably need to be covered temporarily by issuing general revenue bonds, with eventual recovery from assessments against property being developed. Long-run savings should be substantial, particularly if sewerage installation is accompanied by other public investments such as improved roads. Such development guiding improvements might be financed in the same manner as sewerage.

Another process is the purchase of lakeshore property by a public body, installation of public sewerage, roads, etc., and reversion to private ownership. Deed restrictions as well as zoning controls, can be imposed. This device, very similar to urban renewal, would not face many problems, such as relocation, that trouble downtown renewal projects. Many modifications are possible. One option is to purchase "development rights" rather than a fee simple estate in lakeshore property. These development rights, long advocated as a development controlling device, would be returned to private ownership when development is considered desirable.

Alternatives for controlling lakeshore development and containing the cost of controlling pollution are many. With the growing economic importance of second homes in many rural lakes regions and the advantage of low cost pollution control in attracting the seasonal homeowner, steps must be taken soon, else the pace of lakeshore development will erase the significant economic contribution that could be made by comprehensive planning.

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The Cost of Food Aid to Recipient Countries*

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SINCE the passage of Public Law 480 in 1954, there have been two major trends in United States food aid policies. The first has been a gradual transition from the disposal of surplus agricultural commodities to a program emphasizing economic development in recipient countries [1]. The self-help criteria specified in the Food for Peace Act of 1966 high-lighted this redirection [6, Sec. 109]. The second and parallel trend has been a gradual hardening of terms, so that shipments have become more like commercial sales. As a result of the latter trend, recipient countries are facing higher payment burdens. In this paper I endeavor to show how the shift to credit sales in the 1966 Act contributes to the commercialization trend and how by raising the cost of food aid, this policy conflicts with the economic development trend.

Historical Costs

For comparison, Table 1 shows estimates of the costs associated with shipments through 1966 for the four major programs. The total export value of shipments was $15.7 billion, of which 64.9 percent were foreign currency sales, 17.4 percent were emergency relief and donations, and 14.1 percent were barter transactions. The legislation was amended in 1959 to permit long-term credit sales; shipments under this program began in 1961 but constituted only 3.6 percent of the total through 1966. From the viewpoint of recipient countries, each program resulted in somewhat different costs. For present purposes, I will assume that barter sales were equivalent to cash sales, because recipient countries exchanged materials for the farm commodities, and that donations and emergency relief were gifts. The two remaining programs—foreign currency and credit sales—become the primary focus of subsequent discussion.

The payment burden for foreign currency sales can be estimated in a variety of ways, but in principle it is given by the proportion of the foreign currency payments that the United States spends in the recipient country. This assumes that expenditures command resources for purposes beneficial to the United States, and that foreign currencies spent measure the opportunity cost of resources.[1] The allocations for United States ex-

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[1] Cost estimates are based on the *allocation* of foreign currency receipts for "U. S. Uses," rather than actual expenditures. Several difficulties arise in applying allocations

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of all foreign currency sales to a credit basis by 1972 constitutes a significant policy shift. In light of this new legislation, the question arises as to how the new credit policy will affect the payment burden. One way to estimate the burden that has been employed in the foreign assistance literature is to apply conventional discounting theory to the flow of dollar repayments [2, pp. 71–74]. This procedure yields an estimate of the real burden of a foreign assistance loan as a percentage of the loan's nominal value. The lower the interest rate charged on a loan, and the longer the grace period, if any, over which no repayments are required, the smaller will be the real burden and, therefore, the larger the grant element of the loan.

Under the 1966 Act, the maximum repayment period is 20 years at 2.5 percent interest, with a two-year grace period during which one percent interest is charged. Assuming that the loan is repaid in equal annual installments after the two-year grace period, the real burden depends only on the appropriate discount rate. When discounted at rates ranging from 5.75 to 15 percent, the corresponding discounted costs vary from 71.7 to 35.7 percent of the nominal value of the food aid. At a 10 percent discount rate, the cost would be 50.6 percent, which is about double the cost of past foreign currency sales.

The 1966 Act permits certain countries to shift to what is called "convertible local currency credit" (CLCC) sales. Under this option, the United States has the privilege of asking for payment either in dollars or other hard currencies, or in the country's currency to the extent needed for U. S expenditures in the country. While payment in any of these currencies is equivalent to the payment required in dollar credit sales, the princpal advantage for the recipient country is that the terms permitted for CLCC sales correspond to the long term U. S. foreign assistance loans —40 years at 2.5 percent interest, with a 10-year grace period. Under these more lenient terms, the cost of a loan, discounted at 10 percent, would be only 24.9 percent. This is only marginally higher than the cost of foreign currency sales. Consequently, countries that are allowed to convert to CLCC rather than dollar credit will experience a much smaller payment burden.[2]

Other policy changes that reflect a rising cost to recipient countries could be detailed.[3] For instance, since 1964, recipient countries have been required to pay the total ocean freight charges, excluding the difference between the U. S. and foreign flag vessel rates, on the 50 percent that tation, are described and compared to the results of partial analysis of the same area.

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[2] Countries qualify for conversion to CLCC on the basis of their external financial position—foreign exchange reserves balance of payments, and debt service capacity.

[3] On July 29, 1968, the legislation was extended through 1970. In order to improve the U. S. balance of payments, the terms were hardened somewhat further by requiring immediate payment for a portion of credit sales and allowing greater U. S. discretion in spending foreign currencies [7, p. 11].

Pinal County, Arizona, about 85 percent of whose agricultural economy is based on groundwater, was chosen for a case study. This county accounts for about 21 percent of irrigated crop acreage in Arizona, but nearly half of its "water problem" in terms of groundwater level decline. The economic model is derived from the work of Stults. Data on resource organization, production technology, and costs and returns were based on a random sample accounting for 30 percent of all farms over 25 acres in size and 38 percent of all field crop acreage in the county. (Vegetable and citrus crops account for only four percent of irrigated crop acreage in the county. Since water represents only a small proportion of production costs for these specialty crops, their demand and the negligible amounts used for nonirrigation purposes were treated as exogenous requirements in the model.)

The Integrated Model

The need for brevity calls for a rather concise description of the procedure. Operation of the model begins by specifying the initial conditions affecting farmer decisions in period *t*. These are, for each farm size in each subarea: (1) the net return over variable costs for each potential use for irrigation water; (2) the depths to water, and thus the costs of water, in the various subareas of the study area; and (3) the constraints on land and water availability.

These conditions become the parameters of linear programming models of representative farms of the area. There are four farm sizes for each of six subareas. Solution of the 24 programming models gives the cropping patterns that would maximize net income for the individual farmers of the area, given the opportunities and constraints they face with their environment and the groundwater management policy under examination. In addition, the quantity of pumped water demanded under these conditions is determined for each subarea for the given time period.

These quantities of pumped water become the inputs into the electric-analog model of the aquifer.

> An electric-analog model is an electric system that is analogous to the groundwater system. Resistors simulate the ability of the sediments to transmit water, and capacitors simulate the storage of water within the soil pores. The response of the model to the simulated pumping stress is shown on an oscilloscope in the form of a hydrograph. Thus, the oscilloscope acts as a water-stage recorder, which continually measures the water level in an observation well. By measuring with the oscilloscope at different points, it is possible to prepare a contour map of water level changes caused by a specific stress applied for any specific length of time [1].

After computing the average change in depth to water over each subarea, new constraints in terms of maximum pumping capacities by depth to water and subareas are developed for the beginning of time $t + 1$. Because pumpage depths have changed, the costs of water to be entered into the new linear programming models are changed as well.

Several other adjustments in the parameters of the water demand model are made at this time. In each year, a certain number of the wells in the area reach the end of their useful life. A decision must be made between replacing the well or abandoning a portion of irrigated acreage. Well replacement requires a large fixed investment, which must be amortized over the coming years. Well abandonment means sacrificing the expected net return from the crops that could no longer be grown. Crops that would be sacrificed are the *marginal*, low-valued crops such as barley and alfalfa, not the high-valued crops such as cotton or vegetables. Because large farms are more efficient than small farms, large farms can better afford well replacement.

Comparison of the cost of replacing the wells with the discounted stream of expected net returns of potential crops to be irrigated is made for each size of farm. If the smaller farms cannot afford to replace a well but the largest farms can, the acreage that the smaller farmers would have had to sacrifice is assumed to be purchased by the large farmers and the well is replaced. Thus, land is not abandoned because of lack of water until the largest, most efficient units can no longer afford the water cost. Because the larger farms use different production technologies than small farms and have certain other advantages such as purchasing efficiencies, the procedure of projecting changed farm size over time provides a dynamic character to the model.

With the constraints of the linear programming water demand model adjusted to the new conditions, the model is solved for the period $t + 1$. This cycle of calculations is repeated until the end of the planning horizon is reached. Because of the large number of computations required for each time period, projections were made for ten-year intervals rather than annually.

Empirical Results for Pinal County

Table 1 presents the agricultural projections for Pinal County for the years 1966 to 2006. For 1966 through 1968, the actual reported acreages planted are given to illustrate the predictive ability of the model.

The model was constructed in terms of the cotton program in effect in 1966, which had a lower allotment than in 1965. In 1966, the upland cotton allotment was cut to 84,000 acres. Our projections for 1966 overestimated total cropped acres because, while in the model all readjustment occurred instantly, farmers actually take some time to adjust to a new equilibrium. The 1966 projections are thought of as representative of the period 1966–1976. By 1968, readjustment is close to that projected. Alfalfa is adjusting downward, grain sorghum upward, and barley, wheat, and miscellaneous field crops are equal to the projection. Since the 1968 cotton allotment was raised above the constraints dictated by the 1966 program, upland cotton acreage in 1968 was higher than projected. It is doubtful that allotments can remain this high over time, however. Downward adjustments in the cotton allotment would be reflected by increased grain sorghum acres. We submit that the model closely reflects actual farm adjustments.

Table 1. Acreage of field crops, net revenue over variable costs and water use, Pinal County, 1966–2006[a]

Year	American-Egyptian cotton	Upland cotton	Grain sorghum	Alfalfa	Barley, wheat, and other[b]	Total cropped acres	Water use	Net Revenue over variable costs
	thousand acres						thousand acre-feet	*million dollars*
	Actual reported[c]							
1966	7	84	32	21	54	198	—	—
1967	6	81	40	21	59	207	—	—
1968	6	95	38	18	68	225	—	—
	Model projections							
1966	7	84	65	10	68	234	945	29.7
1976	7	84	63	6	65	225	889	29.1
1986	7	84	57	8	58	214	841	28.3
1996	7	84	46	3	44	184	730	27.2
2006	7	84	40	3	38	172	688	26.8

[a] The first three rows are reported acreage in 1966, 1967, and 1968. Data in all other rows are projections of the integrated linear programming—aquifer analog model.

[b] Barley, wheat, and miscellaneous other field crops are treated as a single activity, since net returns and resource requirements are practically identical at present. Barley is the more significant; in 1968, barley acreage was 47,800; wheat, 12,400; other crops, 6,350.

[c] Source: [2, 3].

Projected total cropped acres fall by 26.5 percent over the 40-year period. This is entirely because of rising water costs rather than from a physical shortage of water. Fewer acres of the low-valued crops will be grown. Acreage of high-valued crops, including cotton, vegetables, and citrus, will not be affected.

Annual water use will fall by 27.2 percent during this period. Use falls slightly faster than acreage because less water is used per acre as water costs rise and as farms become larger and more efficient water users. Use would fall even faster except that the high-valued, high-water-using crops become a larger percent of total cropped acres.

Net income over variable cost drops by only 9.8 percent during the same period. There are several reasons. Adjustments in total acreage are entirely of low-valued crops, which are even presently contributing little to net income. In 2006, a much larger proportion of the farms are large farms with lower costs of production. Finally, a larger proportion of total water use is from the small surface supply in the area. As hypothesized, the integrated model showed slower declines in the depth to water than the hydrologic model alone [1].

Conclusion

In this case study, assuming that exogenous forces such as the cotton program remain unchanged over time, the projected decline in net income over the coming 40 years was shown to occur gradually and to be relatively small in magnitude. Elsewhere, we have shown that augmentation of water supplies would be of questionable merit on economic efficiency grounds [5, 7]. It is also not clear that schemes other than "hands off" would prove superior if maximization of present worth of farmers of the area is the policy goal. In any case, the tools to test these hypotheses are now available for this and other groundwater basins.

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"Solid Wastes"—A Resource?*

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WE are one of the most affluent, and *effluent*, people in the world. Recent investigations suggest that over a ton per person of various types of solid wastes is collected annually in the United States [4, p. 13] and over one percent of GNP is spent on collection and disposal [2, p. 3]. What are solid wastes? In addition to garbage and municipal refuse, solid wastes include wastes from commercial, industrial, agricultural, and demolition sources. The composition of solid wastes has been changing dramatically over time, and volume has been continuously increasing.

Pressing problems connected with this growing amount of material have been recognized in many cities and metropolitan areas, and efforts are being made to find solutions. However, solid waste problems are by no means confined to cities and large metropolitan areas. Failure to recognize solid waste problems in rural areas may be one reason why open dumps, open-dump burning, and littering occur and are making many rural areas lose their advantage over cities in environmental quality. As urban frontiers penetrate deeper into rural areas, solid waste problems in rural areas will become more critical. To add to the problems, sparsely populated rural areas are becoming prime candidates for location of disposal sites for wastes generated in large metropolitan areas. The need for attention to solid wastes is accentuated by the fact that governments in rural areas are not as well equipped in manpower, expertise, and other resources to deal with solid waste problems as are governmental units for cities and larger metropolitan areas.

There is an almost unexplainable void in economic analyses of solid waste disposal. The purpose of this paper is to probe economic issues in solid waste disposal and to suggest problems for analytical research.

Approaches to Solid Waste Disposal

A choice can be made in decision making for solid wastes of whether or not to benefit from the increasing awareness of values connected with environmental quality. Solid waste disposal entails transforming solid wastes into heat, gases, liquids, light, or other solid forms and putting these into

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the environment, thus altering the environment. A social choice has to be made about the quality levels of air, water, and visual aesthetics. A direct choice can be made by enforcing standards regulating the disposal of solid wastes. Alternatively, the choice can be made by default, which usually leads to a deterioration of environmental quality. Once the environment is being degraded below a publicly acceptable level, it is difficult to bring about changes reversing the process. However, maintenance of environmental quality is not all or nothing. Questions are: At what level should environmental quality be maintained, and what costs are individuals and groups within society willing to bear to maintain those levels?

One of two general approaches to the disposal of solid wastes is the "destroy and get-rid-of" approach. This approach considers solid wastes to be a nuisance or at best "unwanted things" worth nothing. It leads to a choice of disposal methods that do not make use of characteristics of solid wastes that evolve from their transformation during disposal. The "destroy and get-rid-of" approach leads to choices of technical disposal strategies such as open dumps, open-dump burning, and incineration, which often result in a deterioration of environmental quality because of air or water pollution or adverse effects on visual aesthetics. A second approach is the "useful resource" approach, which emphasizes the use of solid wastes as inputs in creating things of value, ranging from salable products to an environment that is improved rather than degraded by the disposal activity.

Within these two approaches, attention must be given to strategies that refer to alternative technical methods of disposing of solid wastes. Solid waste strategies may be classified as either primary or auxiliary. Primary strategies are final stages of disposal and include sanitary landfills, incineration, composting, open dumps, etc.[1] Auxiliary strategies are intermediate processes which provide storage for or change the form or location of solid wastes. They are used in conjunction with and usually sequentially precede primary strategies.

Some primary strategies compatible with the "useful resource" approach are sanitary landfill, pyrolysis, composting, and reprocessing and recycling of metals and materials. A sanitary landfill is a nuisance-free disposal site in which the refuse is covered each day by a layer of earth that is compacted to provide a tight seal [5, p. vi]. Pyrolysis is a high pressure, high temperature, retort process, which produces water, gases, useful oils, and charcoal ash, from which useful by-products may be extracted. Composting entails decomposing solid wastes to usable soil conditioners. Reprocessing and recycling metals and materials ranges from separation and salvaging of one or few selected components to a decomposition of solid wastes to basic elements and recovery of usable elements.

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[1] Some strategies classified as primary really are not final stages of disposal but are considered such by some in the solid waste industry. For example, incineration usually leaves 20–40 percent residue, which has to be disposed of; and in composting, there is compost and non-compostable items to be disposed of.

Some activities included in auxiliary strategies are: (1) various truck collection systems, (2) high density compression, (3) fragmentization, (4) grinding, (5) pulverization, (6) home refuse freezer, (7) transfer stations, (8) transfer trailers, (9) rail hauling, and (10) pneumatic collection systems. One or more auxiliary strategies may be combined with one or more primary strategies to form a meaningful set of strategies for some set of conditions in a given area.

Strategies need to be fitted into contexts. Contexts are other conditions, constraints, and related activities that are relevant to the functioning of the strategies. The strategies plus the contexts constitute a system [3, p. 50]. Decision problems concerning solid waste disposal faced by local governments involve choosing a solid waste disposal system for their particular conditions. This choice is frequently made without reliable and helpful economic information about alternatives.

Economic Issues and Research Needs

Economic research encompassing detailed and rigorous evaluations of benefits and costs of various strategies and systems would provide information that could immediately be helpful to local governments in making decisions about disposal systems. Although many procedures for evaluating benefits and costs of disposal strategies are straightforward, the sanitary landfill will serve as an illustration for identifying some of the more difficult conceptual and measurement issues.

People usually object strongly to having any type of a disposal site located near them, and the sanitary landfill is no exception. Many objections are not without basis. People living near a sanitary landfill may have external costs imposed upon them because of noise, dust, occasionally strewn paper, probably some odor at times, and congestion problems. These are at a minimum if the landfill is operated according to high standards. The value of property may decrease during the active life of the landfill; and if the property is sold while the landfill is in operation, the loss may be substantial. The location of a disposal site introduces risks that people in the area are asked to bear. An evaluation of the external costs and the types and amounts of compensation for these costs and bearing of imposed risks are important areas for economic investigation and are at the heart of welfare economics.

If geological and hydrological conditions are carefully considered and the landfill is operated with a view to sanitary and aesthetic aims, it is a recommendatory strategy from an environmental quality viewpoint. The intent of the sanitary landfill can be to transform land into an asset that will generate a higher rent than before. The solid waste is a factor of production in this transformation about which several economic questions should be asked. First, if the solid waste is a productive input in this process, it presumably has some economic value. What value? The tendency is to assign zero value to it. Second, completing landfills as rapidly as possible to generate the higher rent makes good economic sense. The present value of the shorter-lived landfill tends to be higher because the benefits are not deferred for as long a period of time. Because of difficulty and costs of opening sites, common practice is to strive for as large a site as possible, which usually takes from 10 to 20 years to complete. Length of active life of a landfill may be one of the factors that motivates people to object so strongly to disposal sites. Assessing alternative rates of filling sanitary landfills for various conditions merits research consideration.

In some cases, sanitary landfills are in effect reclamation projects creating usable land in areas where there is a shortage of land. With proper planning and landscaping, hills or "mountains" can be built from solid wastes which, when completed, provide ski slopes, toboggan slides, and other recreational facilities [6, p. 37]. One landfill in the Chicago area will provide a site for two golf courses, which ultimately will be converted to a cemetery. Some completed landfills produce outputs for which prices or rents are readily estimable, whereas other benefits are difficult to evaluate. Completed landfills are frequently used for playgrounds, parks, ball diamonds, and other similar recreational facilities and help to meet the demand for "user oriented" recreation [1, p. 38], one of the fastest growing demands. Furthermore, while providing recreational services, a completed landfill could concurrently be providing storage for materials to be recovered and reused at some future time. The linkages of solid wastes as a useful resource related to the supply and demand for recreational facilities particularly warrants research investigation.

The sanitary landfill has been discussed as an illustrative disposal strategy. Similar considerations apply to other strategies. Little is known about the short-run and long-run cost structures of combinations of primary and auxiliary strategies. Scale, as determined by size, and population density of the collection area influence costs of different systems. Evaluating strategies can involve complex estimation problems pertaining to purchase and/or leasing costs, opening and developmental costs, as well as the external costs mentioned earlier.

Beyond quantitative benefit and cost analyses, research is needed on the economics of laws, regulations, and private and public compensation, including proposed federal subsidies to encourage high standards of environmental quality. Analysis of how production, handling, and disposal are

EDUCATIONAL INSTITUTIONS IN TODAY'S WORLD

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Mission of Higher Educational Institutions in Today's World

C. BRICE RATCHFORD

WE can say that the mission of institutions of higher education is being subjected to critical reexamination. That's about as much "news" as a couple of astronauts walking around on the moon. What may be really news is that the Cooperative Extension Service, often called archaic and cemented in tradition, has tackled the reexamination of its mission with vigor. Its report, *A People and A Spirit,* is the text I shall cite, paraphrase, and take off from [3]. It is a subject that has a special interest because most of us have lived and worked in the land-grant university tradition of combining abstract thought and research with applied service. From the way we see it, it is tempting to prescribe a large dose of the land-grant philosophy as the answer for higher education.

This line, however, only invites smug self-satisfaction—we dare not indulge. New educational forms, such as urban grant universities, are thought necessary by some. State colleges and junior colleges have issued the challenge that they—not state land-grant universities—are best qualified to reach and relate to close-by communities. So land-grant schools *must also* be included in our examination. Cooperative Extension's study was a giant step in this direction.

Today, higher education finds itself in a new position in terms of public interest and the role it should play in society. In past years, except in the uniquely different land-grant circles, higher education saw itself as charged with educating society's privileged class to serve as leaders in politics, business, cultural enrichment, and social matters. This remained the accepted role until the '30's and probably up to World War II. As such, it was of interest to few people.

An interesting aside—130 years ago when the University of Missouri's first campus was being located, the town of Columbia strongly preferred the state penitentiary and felt the loser by getting the state university.

Two major factors are responsible for the change in the place of higher education in society. The first relates to the real and prestige value of higher education. A college education has become a normal aspiration for

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a large segment of our affluent society. Several special federal programs, such as "Upward Bound" and "Work-Study," are attempting to make it a reality for the disadvantaged segment of society. The result? Soaring enrollments which, along with inflation, higher salaries, and higher academic standards, have so increased the total budget that the cost of higher education is of concern even to non-participants in higher education.

The second factor relates to the entire field of new dimensions that institutions of higher education have added to its duties, sometimes at its own initiative, but more often with urging from the outside. The role of the universities in developing the atomic bomb dramatically impressed the general public with what could be done to implement national missions. Most federal legislation of the last two decades, either explicitly or implicitly, has called upon the resources of higher education. Some legislation could not be executed without assistance from society's primary knowledge center—the university. The professions, business, industry, and labor have joined with the farmers in asking help and have received it.

No longer in question, except by a few traditional faculty members, is the *obligation* of the university to help society solve its problems.

The main reason for the almost universal acceptance of this obligatory position is a hard fact: The institutions of higher education are an unduplicable resource that society needs. The libraries, computers, laboratories, and, most particularly, the faculty have an absolutely unique capability to *assist* in solving some of the major problems of the world. The universities do not want to isolate these resources and society will not permit it.

A second reason relates to the nature of higher education. The higher education community strives to maintain a greater degree of objectivity than any other institution of society. It is more detached from the problems it studies and this not only contributes to objectivity but permits the role of critic, which in its way aids problem solving.

There is a myriad of relevant questions about every aspect of higher education but the clutch policy question of the day relates to the role of higher education in solving societal problems. However, no agreement has been reached on posing the issues, and this is part of our dilemma.

Two diametrically-opposed points of view were expressed in the 1966–67 annual report of the Carnegie Foundation for the Advancement of Teaching [4]. One extreme was stated as follows:

> . . . the university . . . should abjure any conception of itself as an activist shaper of the larger society. It should not "bite off propositions," develop "positions," or be a "protagonist" for causes. It should stick to the pursuits of the academic cloister with which it has traditionally been concerned and carry them out to the best of its ability. All else is illusory.

The opposite position was described this way:

> . . . among all institutions in the nation, the university has the greatest responsibility to be a shaper of the society. As such it has an obligation to identify social wrongs and take an aggressive lead in rectifying them. It must be engaged, activist, reformist . . .
>
> In this view, the university can best protect its position not by an attitude of aloofness from the great social issues of the day but by actively engaging in them. And this kind of activist role, far from detracting from the traditional functions of teaching and research, will actually strengthen them.

These generalities express the division in one way. There are others that relate to the problems to approach, how they are to be approached, and who decides what to tackle. In the quotations, the emphasis on the activist role focuses on the applied research and extension arms of the university; but, truly, it is an institution-wide concern. As an example, the resident instructional program is asked to help solve the problem of upgrading the disadvantaged. To do this, we accept a large number of students from a different culture and end up with a product competitive with the white upper-middle-class.

Administrators have been worrying about the role for several years, and the body of literature is growing larger. Some of the more prestigious contributors include John Gardner, Clark Kerr, Roger Heyns, Samuel Gould, Fred Harrington, T. R. McConnell, and Paul Miller. Recently, the key questions have been brought into the spotlight more by students and faculty.

One extreme point of view would have the university, in a corporate sense, serve as an instrument of direct social action. Few college administrators take this view, but this is exactly what many of the activist students and faculty want.

The reasons for such a view were summarized by Harris L. Wofford, Jr., president of State University College at Old Westbury, New York [5]:

1. The university must be concerned with and contribute to the common good. Any other position is untrue, which is inconsistent with the purpose of a university, and, furthermore, is selfish.
2. Colleges cannot but be agent of change; denying the role is an untruth or a camouflage.
3. Abdicating the role leaves a vacuum that will be filled by less well qualified and perhaps even dangerous people.
4. Direct involvement lends relevance to the entire university program.

The majority of administrators, faculty, students, and the public, while urging much involvement, feel that institutions of higher education should stop short of such an extreme position. One of the most articulate spokesmen for a more moderate view is Chancellor Roger Heyns. His argument is that such a course will strip the university of the very characteristics that make it useful in problem solving—its objectivity and detachment. It would also remove the arguments that higher education has successfully used to maintain academic freedom and the right of self-governance [2].

I strongly subscribe to a moderate point of view. It seems to me fundamentally wrong for the corporate university, or a faculty, to take and promote a stand on issues which do not directly impinge on the institution. This certainly does not imply that faculty members and students should not or cannot take positions and work as individuals to achieve certain goals. Let me add also that I feel the vast majority of institutions have not been sufficiently involved, that they have not come nearly close enough to the line that should not be crossed. So to an extent these arguments have been strictly academic; but they are not likely to remain so in the future.

There is considerable truth to Wofford's argument that a university cannot but be an agent of change. A basic purpose of higher education is to discover and disseminate new knowledge. New ideas, new technology, and new concepts are powerful motivators of major changes in society. It is one thing, however, for the corporate university to make it possible for new "truths" to be discovered and to make them known to decision makers and the public. But it is quite another thing to then actively campaign for action.

Let me give an example that indicates where I feel the line should be drawn, using a very controversial subject—slum housing. It would be entirely appropriate for a university to finance research on ways to improve slum housing. Perhaps one alternative is a rent strike and another an organized march on city hall. It would also be appropriate to make this information available to the slum dwellers. It would be totally inappropriate, however, for the university to proceed to organize the strike or march.

The criticism to be leveled at most institutions of higher education is that they have been insufficiently involved, particularly in the key social issues. Most universities have major programs for developing and disseminating new technology. There is good interaction between the university community and federal and state governments, the business community, farmers, and the professions. This interaction has helped the institutions and individuals solve problems and achieve their goals. Very little has been done, however, by higher education to come to grips with such problems as poverty, racial alienation, peace, slum housing in rural and urban areas, restructuring institutions, and many other pressing problems of society.

John Gardner, in what almost amounts to an indictment, has this to say:

> . . . Generally speaking, when one moves from the arena of scientific and technical problems to those problems involving change in human institu-

> tions, one cannot say that the Universities are a significant intellectual base for the main attack. In fact, a good many university people whose field should give them a legitimate interest in these matters barely understand what the relevant problems are. Many are debating policy alternatives left behind five years ago. Few are planning the kind of research that would sharpen policy alternatives [1].

I feel that Gardner has overstated the situation and that the universities can quickly become as capable in social engineering as they have been in physical engineering, if they choose to so do.

The need to identify and agree upon the Cooperative Extension Service's mission as an instrument of change within the higher educational community led to the establishment of a committee to study the institution. The committee's report relates a good case study of the problems involved in redirecting a well established, large-scale, decentralized institution. Many of the principles relate to the entire university.

The study was initiated because Cooperative Extension was in trouble. It was not under the immediate threat of being deliberately abolished or even sharply curtailed; but rather it was threatened with the prospect of a smaller number of clients and duplication from a number of new agencies in the USDA, other federal departments, and within the university. The once monolithic national structure was being undermined as an increasing number of land-grant universities changed their basic organizational arrangement of public service functions. This provided a division on goals within the organization. Farm organizations and the farm block in the Congress were becoming increasingly divided on the role of the institution. The most irritating criticism was that the institution had nothing to offer to solve the major problems of the day—even in rural areas. This was a common criticism outside the agricultural establishment.

The lack of vigorous redirection within the Cooperative Extension Service supplied the critics with ammunition. For years policy statements by the institution's leaders had said that much greater emphasis should be given to community problem solving, public affairs, improving the quality of the environment, and similar programs. No one ever got around to publicly criticizing the 4-H Club program, but it was clearly observed that the program was not reaching either the problem youth or the serious concerns of all youth. The home economics program in many states was tied to an association of clubs; and, as in the 4-H program, little effort was directed to the major problems of society and to individuals and families who had serious needs.

There had been much experimentation pointing out what could be done. In a few states, emphasis was placed on some of these new areas. When the national statistics were released, however, they showed little change.

and offered suggestions to both universities and the federal establishment for helping this potential become a reality.

The committee recognized that their proposals could not be implemented without some fundamental changes in organization and policies. Some of the more significant changes would include:

1. *Employing personnel from disciplines that can help achieve the program's objectives.* In most states almost every employee of the Cooperative Extension Service has his training in agriculture or home economics. The majority have majored in the technological area. In addition to these disciplines, other types of competencies must be made available.

The report also suggests an intensive program of retraining the present staff to handle part of the redirected program. Our Missouri experience clearly indicates, however, that only a small percent of the traditional staff can be retrained to handle radically different assignments; the redirection must come from new personnel.

The report recognizes, and again our Missouri experience confirms, that the broadened program cannot be achieved by simply making the new work an additional assignment for the traditional staff. In addition to a different type of training, specialized assignments are necessary.

2. *Having access to and contributions from every division of the university.* In the traditional pattern, almost all campus support came from agriculture and home economics. This was true even of the youth program. The necessity of total campus involvement is obvious; but the committee, and wisely so in my opinion, did not suggest how this goal could be achieved other than that it must be resolved at the presidential level.

While the committee was solidly behind this recommendation, it is one of the more controversial items in the report. Questions have come from every division of the university.

3. *Involving other institutions of higher education.* All Cooperative Extension Services funding has gone to the predominately white land-grant university in each state. This is in sharp contrast to today's pattern, which makes possible and encourages participation from all institutions of higher education in federally supported programs. The committee suggested that program responsibility continue to be centered in the same institutions. This is admittedly a prejudiced point of view, but active efforts should be made to work with *all* institutions of higher education. This could be accomplished through sub-contracts and joint appointments. Implementation, however, may well prove to be the most difficult task of all.

In most states with traditionally segregated institutions, the predominately white land-grant university has cooperated with the predominately Negro land-grant university. The specific relations varied, but control remained with one institution. The one issue that the committee was least satisfied with in its final recommendations was the role of the predominately Negro land-grant institutions in the program.

The difficulties arose, not from a lack of desire to help strengthen these institutions, but from the recognition that they need massive support which is far beyond the scope of Extension. Further, it would be unwise to build duplicate systems or even to duplicate some programs. The committee urged a greater involvement of the predominately Negro institutions on a *partnership* basis, along with increased funding to enable these universities to make a greater contribution. Hopefully, the contributions will be in program areas that will strengthen *both the institutions and the total extension program.*

4. *Having more positive relationships with total federal establishment.* The state extension services have had a fine cooperative relationship with the USDA. The results have been beneficial to all concerned. Contacts with other parts of the federal executive branch have been infrequent and on an informal basis. Parts of the suggested programs go beyond the mission of the USDA. Other federal departments have direct responsibility in some of these areas. No other federal department has established a nationwide education network, either on its own or in cooperation with the universities, although several are trying.[1] The committee suggested that formal agreements be developed with other agencies for continuing cooperative work. The logic behind the recommendation was that this was a more efficient method of achieving the desired programmatic objectives.

This brief overview makes it clear that significant movement in the directions indicated will radically change the extension service. It will become involved with some major problems of society in contrast to its former role as primarily a provider of technological services to a segment of the population.

Of greater significance is the possible impact on the higher education community. It is proposed that the organization serve as the outreach arm for this community. The concepts basic to Cooperative Extension operations that would not be changed are: (1) involving the target audience in program development; (2) casting the information within a problem-solving or goal-achieving frame of reference; and (3) encouraging the clientele to act upon the information received. Following these same principles in all of the suggested program areas will take the university closer to the action line that it had gone before. Moving further into the social, economic, and institutional areas suggested will place the university fully in the mainstream of the world.

It may happen that the report will not be implemented. In that case, it has been an interesting academic experience for those involved in its preparation. It is quite clear, however, that if the university had the goal of becoming effective in solving major problems it must devote its resources to the work and have some organizational plan for continuously relating university knowledge and resources to the larger community. Further, much of the work must be done off-campus. These requirements would make it necessary to have the equivalents of experiment stations and extension services in all fields. The committee felt that a single coordinated thrust would be more efficient and more effective in helping higher education carry out its proper role as an instrument of change.

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[1] The USDA is trying to get one established through the STS Act; and HUD, through its Title VIII.

I will conclude with a question and a challenge to agricultural economists in higher education, government, and business. We are pleased that the report calls for more economics and therefore more economists, which will lead to a better market for our profession. I submit that this happy possibility will not be realized if we insist that our contributions be made within our professional ruts. I ask, is the profession improving its capacity to perform in the areas of concern that lie beyond the traditional farm management, marketing, and farm policy subject areas? Are we ready and able to subordinate our individual concerns and work together as a part of a physical and social science team on problems of environmental quality, economic injustice, regional planning, delivery of services to human, and other major problems of the day? I hope the answer to both of these questions is yes.

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Social Science Needs in Agriculture and Natural Resources Curricula—The CEANAR Report*

CARROLL V. HESS

MY task here, in the brief time allotted, is to summarize the recommendations and the rationale underlying the CEANAR Committee's Report on the Social Science Education Needs for Undergraduates in Agriculture and Natural Resources Curricula. The Committee's specific charge was to recommend desirable education in the social sciences for undergraduates in agriculture and natural resources to fulfill:

(1) the liberal education dimension of their undergraduate education;

(2) supporting the professional education needs of undergraduates in non-social science majors, e.g., Agronomy, Animal Science, Food Science, Forestry; and

(3) supporting the professional education needs of undergraduates in the social science-oriented curriculum, e.g., Agricultural Economics, Agricultural Business Administration, Rural Sociology, Rural Community Planning and Development, Recreational Planning, and International Economic Development.

First, permit me to capsule for you the nature and magnitude of the social, economic, and political environment and issues that seemingly call for a greater understanding by faculty and students of the need for an increased role for the social sciences in today's modern university professional education.

American communities today are faced with massive social problems. The annual level of investment in the development of technology has reached the 23 billion dollar level in the United States. Seven billion of this is investment by the private sector, with the remaining 16 billion representing public investment in technology. These high investments generate enormous changes in capital input supplies and engender growth in goods and services of all kinds. As firms operate in this capitalistic society and respond readily to these huge injections of technology, increased specialization, economies to scale, and structural changes within the economy are accentuated.

Many communities are not prepared to meet these massive changes.

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* This is an abstracted report of a committee to study recommended social science needs for undergraduates in agriculture and natural resources, appointed in 1968 by the Commission on Education in Agriculture and Natural Resources, National Research Council, National Academy of Sciences.

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One measure of public concern is that in 1946, the Federal government spent 894 million dollars to help local governments augment their public programs. By 1966, this figure reached over 14 billion dollars, a 16-fold increase in a mere 20 years.

A myriad of community problems needs solutions—equitable taxes; educational expansion and relevancy; adequate local government; racial reconciliation; elimination of poverty; modernization of laws and public codes; improving the quality of the environment; the maintenance of public order under newer structural and social systems and conditions; sufficient health services; better transportation and communication; and finally the human desire fulfilled for beauty, dignity, and well being. Adequate progress toward solutions can arise only from citizens whose understanding is in perspective with the times. Science and education must be uniquely organized for the purposes of social innovation as they had to be for technological innovation.

Our land-grant universities were developed during a period in history that demanded expansion and application of the biological and physical sciences. The agricultural and forestry colleges, with their experiment stations and cooperative extension services, were among the great innovations in American social and economic history. This system of research and education was an important instrument in our developing nation through the invention and introduction of new technology. These technologies, which have freed us—or many of us—from hunger and want, have helped to create major social issues and conflicts. Thus, the committee felt it proper that we consciously examine the proper place in agricultural and natural resources curricula for the social disciplines to contribute to an understanding and resolution of the social issues arising as a kind of technological backlash from the massive injections of technology into agriculture. Technology has thus been a mixed blessing, by no means subjected as yet to effective social control. Furthermore, there have been few, if any, periods in which our social structures have been more critically challenged for their internal inconsistencies and inequities. Thus, the social sciences are directly charged with the study of society, which is today in turmoil. Social Sciences in this report refers to economics, sociology, anthropology, political science, geography, and psychology.

To excerpt from the committee report: "The social sciences focus on man's behavior and the ways in which he interacts with his fellowmen through social, economic, and political institutions to implement his aspirations and values. . . . Thus it is to the social sciences that we must turn if man is to assert his dominance over his technology and face constructively the manifold social issues of our time . . . without reasoned and objective approaches to these matters, we can rely only on expedience and luck to avoid chaos."

The committee recognized that agricultural and forestry colleges are properly concerned with professional education. At the same time, the student must live his professional and personal life in an explosive world with all its unresolved issues. While education in the social sciences cannot always yield instrumental social knowledge, it is vital to alert students to the man-created conditions that will persistently impinge upon the practice of their professions and their lives in the community.

Recent improvements in secondary school education have occurred notably in the areas of mathematics and biological and physical sciences. These developments have not been matched in the social sciences and humanities. Thus, colleges and universities have accordingly drawn the increased burden of sensitizing students in these disciplines to their changing social milieu and assisting them in interpreting it.

Although modern society has profited from the advances that have been made in the physical and biological sciences, it has found it increasingly difficult to adjust old institutions or to establish new ones to take full advantage of the new technology. The pressures created by our burgeoning populations have placed special emphasis on land-use conflicts and on the need for increased understanding of the complex socio-economic culture in which we live. Modern-day faculties and students alike are concerned about an educational process that produces persons filled to the graduation mortar board with "scientific" facts but fails to provide them with an understanding of the nature of man and of the institutions man creates in his attempt to optimize his individual and societal goals.

There is growing awareness that an agricultural and forestry "professional" is more than a "technologist". It is widely recognized that he must be an educated man who can adapt rapidly to changes in both technology and social goals and that in order to meet this challenge he needs a more liberal type of education than has traditionally characterized agricultural and forestry education programs. An example of one response to this need is the growth of two-year programs that produce technicians who can free the professional to concentrate on social problems of decision making, policy formulation, and public planning.

The variety of subject matter and career opportunities in agriculture and natural resources encourages some flexibility in developing social science training for agricultural students. The social science contributions to the production-technology or business options, for example, may be quite applied in nature, serving an "instrumentation" function. On the other hand, it may be more appropriate to use social science courses to create a philosophical background that should help students in agricultural science to appreciate both the biological science teachings and the applications of them in the service of humanity.

Likewise, in the natural resources area there are some special needs.

"People problems" involving political action, aesthetics, use preferences, and qualitative judgment have replaced the old problems of sustained yield, habitat manipulation, and methods of inventory. This transition is especially evident in outdoor recreation, a newly emerging field of resource management. As a result, educators in resource management are calling for greater social science contribution to their undergraduate programs.

In short, today's graduate of an agricultural or natural resources curriculum works largely with complex problems requiring a broad interdisciplinary background for their solution. He must be able to communicate with, and understand, something of the methods of engineers, planners, and social scientists who contribute to the analysis and solution of his problems. The undergraduate in agricultural or natural resources must have increased exposure to key subject areas in social science, if he is to help these teams of specialists to achieve their full potential usefulness.

Recommendations

The committee, in its report, defined the six social sciences involved and outlined specific ways in which each of these disciplines might contribute to the social science education of undergraduates in agriculture and natural resources. The time limitation will permit me only to outline their general recommendations as follows:

The committee emphasized flexibility—flexibility for the student to add new disciplines, including the social sciences, to accommodate the increasing maturity of today's students in professional colleges and their desire to achieve more specific goals. Social science courses taken early in the bachelor's program exposes him to a new fund of knowledge, shows him how social scientists perceive the world, and sensitizes him to a wider range of vocations and life styles. Flexibility also permits students to fashion a program more compatible with his specific professional needs and goals.

The committee specifically recommended that undergraduates in agriculture and natural resources devote 15 to 20 percent of the curriculum to the social sciences. We further recommended that the set of courses should include depth in at least two of the six social science disciplines and that the general education experience in the social sciences should be similar regardless of the professional specialization.

The recommended 15-20 percent allocation to the social sciences represents a significant increase in most instances. We felt justified in making this strong recommendation because greater progress has been made at the high school level in strengthening the student's foundation in the biological and physical sciences than in the social sciences. Little hope exists

Colleges, he had another vision: "The size, departmentalization and professionalization of the college with consequent bureaucratic behavior have destroyed much of the colleges' early flexibility and formal capacity for pragmatic problem solving, ..."

About the extension report under consideration, an editorial in one of the prominent national commodity magazines predicted: "We see being planted the seeds of disintegration of agricultural extension as an effective and dedicated service to farmers" [3].

3. *The agricultural establishment of the land-grant universities has continued to receive larger funding—surely one tangible evidence of citizenry support for research and extension.* The fact that long-run spending patterns of federal and especially of state and local governments for these purposes have trended upward is a matter of record. There have been exceptions, of course, in certain years and for certain states.

This hurried and very general historical perspective does not guarantee larger funding and broader services for the future for research and extension. But neither does it give the current crop of prophets of doom additional perception denied mortal man about a demise of the experiment station and the extension service.

My perspective does give credence to a hypothesis that the agricultural establishment in the land-grant universities likely will not only survive but grow as it provides increased needed services. In more pragmatic terms, these services probably will be around when those of us in this meeting retire.

Research and Extension Changing

The report, *A People and a Spirit,* a 95-page, two-year evaluation requested by the Extension directors, is appropriately timed for the tensions and ambiguities involving public service and is further tangible evidence that adequate sensitivity, perception, and adaptive capabilities do prevail in the land-grant universities [2].

As a matter of fact, extension and research have been shifting emphasis even with present funds. Considerably more emphasis is now placed upon policies affecting taxation, community services, schools, and related issues. Also included are special problems of people located in low income rural areas. "Test runs" are being made to improve opportunities for disadvantaged people in cities, e.g., through inclusion in 4-H activities and nutritional assistance programs.

Extension leaders today generally recognize that programs must be people oriented. They understand, as Paarlberg said in 1965, "Commodity programs treat some people as if they were fifty feet tall and others as if they were midgets. People oriented programs accept each at his own stature" [4, p. 20].

political party in power permit transfer of these new functions to less politically responsive institutions? For example, will the chairmen of the House and Senate agricultural committees react to a dilution of their perogatives and responsibilities?

The second determinant pertains to the power of *federal adminstrators.* Will the Secretaries of Health, Education and Welfare and of Labor support a policy of transferring city oriented functions to traditionally agricultural and rural oriented agencies? In recent years, they have been determined to originate policy for areas within their own commands.

The third set of the quad-aggregate determinants—the *economic institutions*—are effective participants in policy making, too. Owners of the larger commercial family farms, and even corporation farms, vertical integrators, and directors and managers of cooperatives illustrate the agri-economic institutions I have in mind. These superb strategists want to know whether the expanded research and extension program will assist them substantially in reaching the ends they seek. They want answers to such specific questions as: Will these institutions help us in gaining more market power? As large farmers and agricorporations, why should we pay extension for educational assistance?

The fourth and final determinant is *interest participation.* How far will the farm groups support the land-grant university proposals? Which group will fight, and to what extent, against increased funding? And what about the attitude of the whole gamut of national business associations, labor unions, and the increasing numbers of groups proclaiming to protect the consumer?

The power structure of three of the four policy determinants—the political institutions, the economic institutions, and the pressure groups—was not formally involved in the "People and a Spirit" study. This may prove to have been a mistake. Inefficiencies, resulting from lack of proper understanding of policy determinants, could result in the fading away of the excellent targets enunciated in the report and the assignments going to less deserving, but more politically astute, agencies.

Guidelines for Corrective Measures

In addition to reading and weighing properly the external determinants affecting them, the experiment stations and the extension services must see that proper guidelines are established and necessary corrective measures are taken in their own organizational structure to insure appropriate and effective programing, leadership, and subject-matter areas. I believe they will.

Here are a few guidelines:

1. Additional skills and insights are necessary to generate more effective group decision making on matters of social and economic develop-

ment. Group decision making is far more complicated than individual decision making.

2. Extension and research functions must be thoroughly understood and amply supported throughout all sectors of the university and by the president and the board of directors. The total knowledge base of the university must be accessible and usable with very short notice. There is no place for institutional rigidity in today's ball game.

3. Extension and research must gain access and rapport with the other federal agencies with which there will be cooperation equal to that enjoyed with USDA. This will not be an easy task, for even the rapport with USDA is not what it once was.

4. The land-grant universities must effectively demonstrate and communicate to the executive and legislative branches of government and to the farm and non-farm publics served that it is far less costly for the extension services and the experiment stations to provide needed assistance than to establish new parallel urban agencies.

5. Sometimes, professional staffs experience difficulties, after working with "commercial people," in adjusting to work with low-income groups and low-income alienated groups. These difficulties can be overcome through study and practice. A sociologist shocked the negro agents in one state in a meeting by pointing out they did not really understand the low income negro problem because they were actually middle income citizens.

6. Training the field personnel of agribusinesses, as the report calls for, will require delicate and persuasive maneuvering, and by extremely competent personnel. Some of these agribusinesses are in the training business now. Farmland Industries has recently developed a program to help local cooperatives find new employees. They plan to train some 300 rural persons under a contract between the Cooperative League of the USA and the U. S. Department of Labor. Farmland is the subcontractor. Consultation on educational phases will not be with the land-grant university or USDA personnel but with the U. S. Department of Health, Education and Welfare.

7. As agricultural economists, we need to return to devote a greater part of our time to areas formerly described as *institutional economics* and *political economy*. Hardin's concept of *programmatic research* also should receive more attention [6, p. 359]. This is making an analysis of the agricultural and nonagricultural governments in the United States. Hardin believes this type of research and extension work is needed urgently to provide a safeguard for a vigorous federalism, rather than the creation of irresponsive central agencies which may overreach themselves [6]. Such studies and educational work would provide also a clearer insight of the opportunities for additional funding for research and extension.

Summary and Conclusions

My overall conclusion is optimistic: The state experiment stations and the state extension services will continue to make policy and program adjustments, but not of the magnitude nor substantive content deemed desirable by the agricultural economists—nor the animal scientists for that matter. But the administrators will do so in terms of the power structure in the four determinants of policy making in the United States. Consequently, political support for continued increases in funding and services in the decade ahead will be forthcoming.

To be specific, if I were a young man, I would not feel insecure about doing my graduate work in agricultural economics and accepting a position in either research or extension, or both, in a land-grant university. First, I believe we have a right to be as proud of the achievements of our profession as are members of other subdisciplines of economics, whether monetary or labor economists or economic theorists. Secondly, I believe our land-grant universities are competing well with other great universities and cooperating agencies.

In short, the land-grant universities and the agricultural economists have the demonstrated competence to compete successfully in the future —if we want to—and if we are determined to do so.

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AGRICULTURE IN THE ECONOMY OF THE FUTURE

CHAIRMAN: GEORGE E. BRANDOW, PENNSYLVANIA STATE UNIVERSITY

On Institutional Obsolescence and Innovation

LEO POLOPOLUS

> "The social system you save may be your own."
> —Kenneth E. Boulding

COMPETENT, extensive, readable, provocative, and relevant describe James Duncan Shaffer's public policy essay published in the May issue of the Journal for purposes of professional dialogue and debate [16]. The paper is remarkable because it demonstrates the enormously widened aperture of the contemporary agricultural economist in matters of policy. One need only to review the previous works of Benedict [1], Halcrow [7], Shepherd [17], Paarlberg [12], and even Hathaway [9], for example, to confirm this notion.

As a cursory overview, Professor Shaffer's paper deals with six broad aspects of public policy affecting or affected by our institutions: the social system and the effects of technology upon the system, external effects, protective and bureaucratic institutions, industrial organization and competition, community and economic development, and finally, the role of the professional agricultural economist in public policy research.

Shaffer concludes that both public and private institutions are becoming obsolete in terms of protecting society's general welfare. The rate of institutional obsolescence is positively influenced by the rate of technological change. Protective institutions are created by vested interests to protect monetary gains of the scientific-industrial process and to vitiate negative effects. The external effects, mostly external diseconomies, are pervasive symptoms of the social order. What are needed are innovative institutions to redress the organization of markets and communities to lessen the problems of the disadvantaged and to provide a more equitable distribution of the wealth created by the economic system. A plea is extended to the agricultural economist to contribute to the reformulation of viable institutions, particularly in rural areas. Specific comments and interpretations of Shaffer's paper are presented below.

The Social System and the Effects of Technology

Shaffer, as did Galbraith in *The New Industrial State* [6, p. 20], correctly posited the mutual interdependence of technology and social or-

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ganization. Technology cannot properly replace social engineering [20, p. 52], but it can serve to perturb the social nostalgia that continually persists and resists change. Galbraith [5, p. 138] and Eric Hoffer [10, p. 3] both argue that certain conditions must be present before change is introduced and effective action taken. Shaffer does not specifically mention the "shock effect" of the scientific industrialization process, but apparently implies that the shocks of change are absorbed by those persons and institutions least able to mitigate their effects. Also, the extreme and pessimistic view of French sociologist Jacques Ellul, that technology is so extensive that it controls and dehumanizes society [4, p. 54], is obviously rejected by Shaffer's optimistic hope of finding corrective and innovative institutions.

What becomes clear from a reading of Shaffer and other works on technology and social change is the lack of a uniform theory or at least a set of rules that states the relationships between certain types of technological conduct and the performance effects within the system. What is needed, for example, is a set of institutional innovations based upon scientific knowledge, less random and uncertain in their consequences and more fully in accord with man's desires [11, p. 542].

The view by Shaffer that the social system is dynamic is undeniable. However, his belief that dynamic systems cannot be described by models seems to throw excessive cold water on empirical attempts to develop such models. The conceptual framework of a systems model developed by Langham, for example, is specifically oriented toward societal and institutional change that is continuous, renewable, and responsive. Langham's approach involves incremental improvements to systems performance and it purposefully includes conflicting interest groups [12].

External Effects

Shaffer leaves no doubt that the present institutional arrangements are inadequate to deal with the problem posed by externalities. His hypothetical sketches of the DDT and river pollution cases are strong indications of his keen insight. While some external effects may be beneficial or economical to the system, such as pretty girls and well-landscaped lawns, Shaffer emphasizes the external diseconomies case. This is correct and relevant since external diseconomies, not external economies, cause public policy problems.

There are three alternative courses of action available to deal with serious external effects—contracts, internalization, and regulation. Contracting may occur when the party imposing the external diseconomies is willing to negotiate with the suffering party to their mutual advantage. Internalization would require that all of the effects be absorbed by a firm or a group of firms. Both private contracts and internalization, however, are not suitable to lessening most of the externalities adversely affecting the social system. And while regulation generally limits the external effects, the imposition of a tax to thwart bad external effects may be unwise without thorough examination of the situation [18, p. 309]. Shaffer does not clearly point a finger on an approach to ameliorate the harmful effects of externalities.

Protective and Bureaucratic Institutions

Shaffer argues that protective institutions are established to modify the marginal adjustments of the market and prevent Schumpeterian creative destruction. One could extend the discussion of this point and suggest that a code of institutional ethics should be required to circumscribe the actions of these institutions within the general public interest [15, pp. 193–203]. It is too easy for large corporations and other bureaucratized institutions to say, "What is possible legally, politically, and economically is therefore ethical." Our need is to search for new forms of organizations that might broaden the ethical purposes and socially beneficial influences of corporations, federations, cooperatives, nonprofit organizations, professional societies, trade and industrial associations, governments, and churches.

Industrial Organization and Competition

Despite the fact that considerable aggregate wealth is concentrated into the hands of the largest 100 corporations, industrial organization economists generally argue that the evaluation of competition is relevant only in narrowly defined product or service markets [1, p. 92]. Shaffer does not articulate his position very well on this matter. He should have tied his discussion of corporate bigness more closely to the emerging and potentially harmful effects of the conglomerate firm. Conglomerate mergers accounted for 84 percent of the number and 89 percent of the assets of all recorded large acquisitions in 1968 [19, p. 3]. While conglomerates are a special kind of protective institution, economists have not sufficiently analyzed their impact upon individual industrial markets nor their overall effect upon society's welfare.

In the food industry the large corporation has been able to proliferate new products with bewildering rapidity and ingenuity. Shaffer is well aware of these developments and is appropriately concerned about the ultimate consequences. He raises a fair question: Will the "inferior" analog or substitute win in competition with the "superior" traditional food? This problem cannot be as readily answered, as implied by Shaffer. The related public policies that deal with the problems posed by synthetics and agricultural substitutes involve the traditional agricultural policy, policies dealing with the health and welfare of consumers, antitrust policy, and policies affecting public research and development expenditures. It has been argued elsewhere that changes are needed in public policies affecting both the agricultural and nonagricultural dimensions of the problem [14].

Community and Economic Development

The strongest section of Shaffer's paper deals with his accurate perception of poverty in an affluent society. Technological displacement, the failure of farm policy to lessen the incidence of poverty, alienation between governmental agencies and the people presumably being assisted, the negative effects of the property tax for home improvement, the obsolescence of local governmental institutions, the maldistribution of income, and the denial of "new property" to the disadvantaged are some of Shaffer's main points.

Shaffer's proposal to create a federal mutual fund to give the poor a slice of some "new property" seems reasonable in principle, but the specifics do not appear workable. While innovations are increasing at a rapid rate, there is little evidence that the public research sector has provided a substantial volume of commercially feasible products and techniques in relation to the private sector. Much of the public sector's research is basic in origin. There is also no assurance that the innovative contributions of the public sector will provide a continuous or adequate flow of revenue to the mutual fund. It is doubtful that a fund so conceived could alleviate much of the prevailing poverty or redistribute incomes in any meaningful way.

The Role of the Agricultural Economist

Many agricultural economists are able and willing to accept Shaffer's challenge to become more involved with the broad and complex aspects of social change. Unfortunately, they must do so usually within an internal work environment that seeks to avoid controversy and an external atmosphere that questions the role of the agricultural economist. The internal research environment is hampered by administrative and political resistance [8, p. 227]. Externally, economists, like Boulding, argue that there is a misallocation of intellectual resources within the United States, and that, like medicine and law, agricultural economics drains a disproportionate share [3, p. 111]. Aside from the inconsequential lobbying activity of our protective institutions, e.g., professional associations, agricultural economists must demonstrate their responsiveness by individual deed and action. So far our contribution has been negligible. Hopefully, Shaffer's article will start some wheels rolling.

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I See It Differently*

RADOJE NIKOLITCH

DEEP in the root of Professor Shaffer's article is a philosophical credo that shapes all its aspects—beginning with the motto, expressed concerns, interpretation of developments, and trust in innovations. The concept of changes is so overwhelming that it gives the impression of being a crusader's banner rather than a yardstick for measuring economic, social, and political events.

I have read and reread the article with great interest. It is an excellent and inspiring article—but, somehow, I am uneasy about its lack of critical balance, and I cannot acquiesce in its reasoning. No, I do not believe that "we must rethink all our old ideas and beliefs before they capture and destroy us." May I suggest that such a motto is not without emotional appeal and political orientations.

Let us modify the concept and say: We must adapt ourselves to new circumstances. Have we not done this since the beginning of the world? In such a gradual process of action and reaction, neither our old ideas and beliefs will capture and destroy us, nor would we be tempted to destroy them. This way we can meet new challenges and still keep the treasured institutions of our western civilization, which have passed the hard tests of centuries of historical reality.

The aim of this brief paper is not to suggest solutions for all of the issues raised. For this I lack the confidence and optimism so abundant in Professor Shaffer's article. The limited length of this paper also necessarily restrains its scope. However, I shall raise my doubts, first, about some of the interpretations of the process of institutional obsolescence, and second, about the "necessary activity" of institutional innovation. This I intend to do, not by elaborate discussion of concrete developments, but by a general glance at the basic problems. Or, to express myself more directly, by cautioning against overestimating the power of change and having too much optimism in innovations.

Obsolescence and Innovation

Whatever is new has a long history. Novelty is only a long process of adaptation. This is the natural law of survival, from which human society is not exempt. Of course, things are changing and our survival and suc-

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* The views expressed in this article are those of the author and do not necessarily reflect those of the Economic Research Service or the U. S. Department of Agriculture.

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cessful life depends primarily on our capacity for adaptation. What happens today started a long time ago, and because it happened, nobody is the same as before. But adaptations and changes cannot be separated without grave dangers. There is also a fallacy in believing that changing by itself means bettering. "History suggests some doubts about this."

The frightening rate of population increase could not be sustained without a mammoth technological advance, which in turn is prompted by the survival efforts of the growing billions of people. The anthropologists suggest that the structure of our hands shaped the development of human beings, but there is no doubt that what we put in those hands shapes human civilization.

It seems that we all agree on the inevitability of change. Our differences lie in where we put our emphasis. This seems to boil down to the question about *how* changes should be made and *who* should make them. In this respect I cannot but admire the English common law. There, wisely, new aspects of human activities, behavior, and interrelations are left to the reality of life itself; and, when commonly accepted as a practical or ethical rule, they are recognized by the courts and become law. It is wonderful how Great Britian liquidated one of the biggest world empires, without, practically speaking, changing any of her basic institutions.

It seems to me that our human society was always better off when changes came through the grind of life itself than through the wisdom of planned innovations. Democracy, which is in essence a compromise and balance of conflicting human interests, is the best fitted institution for the somewhat slower process for changes through adaptations. Certainly, our profession can contribute greatly to make that adaptation easier and more efficient—mostly by presenting to the society the alternatives that result from our scientific endeavors. For those among us who have also the privilege of being professors—by giving the best possible education to the oncoming generation. Indeed, education is the best hope for human progress. Whatever else we do, we cannot succed in making a better society without bettering men themselves.

It is evident that, through different concepts about change, the problems before us reflect themselves differently. It is like looking through variously colored glasses. Let us mention briefly how some of the problems raised by Shaffer can reflect themselves.

Some Different Outlooks

The main concern expressed in his article is about "a growing discrepancy between the quality of life enjoyed and that which is potentially attainable" [1, p. 245]. Through my glasses, I see "life enjoyed" getting better for an increasingly larger number of people—at least in free and democratic societies. "Life potentially attainable" is a nebulous concept;

hence, the measurement of the gap between them is more an emotional process than anything else.

Through the same glasses, I see primitive men in their wilderness at least as interdependent on each other (food, defense) as in presently scientifically industrialized societies. Also, the assumption that men are now less dependent on nature than before [1, p. 246] can hardly be substantiated—let us not forget our grave concern about the possibility of a forthcoming catastrophic hunger crisis.

I see adjustment of our institutions to new circumstances as an imperative. Not less necessary are due processes of legislative and administrative activities, in order to organize and manage our society the best way we know how. However, I am skeptical that much good could come of an "organized intellectual effort directed at institutional innovations" [1, p. 246]. First, I do not know whether "intellectual effort," once organized toward a specific social goal, could retain its intellectual independence and scientific aloofness. Such an organization could result in creating a new bureaucracy (as if we did not have enough of it throughout human history)—and that might not be the worst of it. Second, although I look at science as one of our best hopes, I cannot commend the direct participation of scientists in the management of our society. Good advice to researchers in any scientific field probably would be: *Find the truth, and the truth will find its way to usefulness.*

Technological displacement [1, p. 257], income distribution, and the "new property" [1, p. 260], under whatever aspects treated, are old social problems. Technological displacement is followed always by painful readjustment for some groups, but it is indispensable for progress. Are we not justifiably proud that our technological advance in farming released so much labor force for other social tasks? Neither our institutions, nor technology, nor "property tax" could be responsible for the fact that some segments of some communities remain alienated—outside of total social integration. The causes of this alienation are many-sided, some of them are tragically serious. If an able-bodied human being stays for a long time unproductive, and as a consequence unprotected, the tragedy of his situation lies in his unproductiveness.

This tragedy cannot be eliminated through help, whether called welfare, grants, or "new rights" [1, p. 262]. Besides natural and social disasters, individuals or groups of individuals throughout history have been unproductive mainly either because equal opportunities were denied to them or because they were unfit to take advantage of opportunities that were available. In either case, the ultimate remedy was and is still today in education. Our colleges and universities can make an important contribution in this respect, much more than by "nurturing the social critic and support extensive dialogue on issues of public policy" [1, p. 264]. Education is overwhelmingly important for solving our social problems. However, we should not forget that *discipline* is the first step towards education; and *self-discipline,* toward a successful and happy individual as well as social life.

Through my glasses, the creation of "the U. S. Inheritance Mutual Fund," which "would own, in the name of the citizens . . . rights of all scientific discoveries, inventions, and commercially exploitable ideas which derive from the work of scientists and technicians supported by Government funds" [1, p. 262] looks as unpracticable as theoretically twisted.

Tremendous readjustment in farming, and the impact of the readjustment to its organization, is a good example of the limited power of changes. Despite the profound changes that are in the offing, farms continue to be mostly relatively small, family-operated, and family-owned business—95 percent of all census reported farms and 64 percent of total farm marketings. Self-employment continues to be the dominant labor force in farming—75 percent of total farm employment. Farm managent continues to be widespread, and farmers continue their firm control over farm production resources, including land itself—mostly through ownership.

Finally, let us look through my glasses at Professor Shaffer's last statement that ". . . a meaningful life for all the members of our society is limited only by our will and creativity in structuring our institutions" [1, p. 266]. A meaningful life for all is a human dream of long standing, a goal to which I wholeheartedly subscribe. But to believe that we can achieve this goal by "structuring our institutions" is a dangerous illusion.

At the beginning of my comments to Shaffer's article, I suggested that the article is not without emotional appeal and political orientations. Looking at my comments, I see that they too are not entirely exempt of emotional appeal and, maybe, of political flavor. My only excuse is that I necessarily had to pass through a door that Professor Shaffer widely opened.

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Institutional Engineering—Venture into Applied Behavioral Science

DAVID H. SPAETH

I APPROACH the task of responding to Dr. Shaffer's article with some hesitancy. It is a bit frightening to work in a remote corner of the full range of activity in agricultural economics and then to find that many of the once remote issues and concerns have become central.

I make no apologies for the personal nature of this paper. It is in the nature of a travelogue—a report of adventures in the world of applied science from the frontier of the urbanization of rural America and the jungle of state governments in transition. There have been two vehicles for this exploration: first, extended participation in the design of programs for Appalachia and other developing areas of Kentucky, sponsored by three successive governors of the state; second, participation in the activity arising from a Ford Foundation grant to former Governor Edward T. Breathitt of Kentucky to continue and extend the work of the Commission on Rural Poverty.

To continue the metaphor, it is my intent to point out some principal features of the area of applied institutional engineering, the problems likly to confront the venturer, and to comment on appropriate equipment. More specifically, I wish to deal with the hierarchical nature of goals in the world of goal-oriented systems used in development programming; with the confrontation between invention and trend, budgets and imagination, planning and programming; and with the nature of the practice of applied behavioral science.

Hierarchies of Goals

This particular discussion is direct toward the following statement from the Shaffer article [1, p. 246]:

> Effective public policy requires management of the evolving system, and effective management requires an understanding of the dynamics of the system. But even more, it depends upon organizing our institutions to direct the system to achieve desired goals rather than accept whatever pattern organization evolves.

It has been my experience over the past several years that the accurate identification of goals has been the most critical and most demanding element of deliberate institutional innovation and engineering. The meetings and interview sessions that lead to the phrasing, rephrasing and refine-

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ment of statements of organizational charter or mission often take on many of the characteristics of psychoanalytic sessions.

To illustrate, one principal activity in which I have been able to participate is the construction of management information systems for units of state government charged with management of the state's water resources. The need that usually initiates the move to set up such a management information system is the desire to improve the response capability of the state agency to the demands for data analysis by decision makers. The adoption of the need as a goal usually leads to a move to establish a computerized data bank. Such a move never addresses the questions as to the adequacy of the existing data, what new data is worth gathering, and what useful new analyses could be performed with the expanded data-processing capability. In each case, in order to establish a useful, workable, and reasonably efficient system, it has been necessary to exhaustively ferret out the mission of the state agency within the framework of the larger governments. When the unit in question is a planning and research arm of one division of one of a dozen agencies dealing with water resources, the identification of goals can become a sensitive and even explosive activity.

The hierarchical nature of goals has been implicit in the foregoing example. It became explicit when we at Spindletop attempted to give some structure to the many recommendations of the Commission on Rural Poverty. It became very obvious that some of these recommendations entail changes in broad national domestic policy; others require changes in the structure of implementing agencies; still others, changes in the missions of these agencies. We are presently engaged in "prioritizing" these recommendations to form a workable set of goals, with some sense of sequence and logical interrelationship. We feel this is necessary to the formation of a national program to deal with the problems of rural poverty and to bring the very large cost into perspective.

May I comment in passing that my work with the recommendations of the Commission on Rural Poverty has led me to the conclusion that the very broad statements near the top of the goal structure for dealing with rural poverty will have to include some explicit statement of position or policy with regard to rural settlement patterns and domestic income distribution. Both of these issues are recognized in the Shaffer article [1, pp. 260–261].

Planning and Programming

The terms planning and programming can almost be labels applied to battle lines. In the regional development business, the battle shapes up between those who would evaluate and predict the viability of a community or area and those who design programs to materially alter the basic factors and assumptions underlying the evaluation and prediction. Within state government, the lines are drawn between those desiring to forge programs to solve problems within the state and those who worry about allocation of state revenues. In federal-state relationships the tension develops as state-level program developers engage in "grantsmanship" and the federal employee seeks to defend his judgments by constructing "objective" allocation formulae. These tensions strike hard at the economist who gets caught up in program design. Starting with the classic definition of economics as a science dealing with the allocation of scarce resources, it is disconcerting to work with the notion that if the time constraint is relaxed the resources are not so scarce. Add to this the non-additivity of individual projects that are mutually supporting, and many of the more familiar tools of economic analysis become inappropriate. My own statement has been that in area development programming it is not necessary to say "no" to anyone, just "tomorrow." The problem of Smithsville's school vs. Jonesville's hospital is solved by saying that both will be built in some sequence that makes sense in terms of the more comprehensive program in which the projects are embedded. Viewed in this fashion, the aforementioned antagonisms find their resolution by defining the comprehensive program of activity. The program process is then paced by politically determined funding, in turn influenced by program content. The plan and accompanying budget are then that part of the comprehensive program and funding falling within a given time span. In this way the allocation problem is solved by the programming process. Ideas are funded, rather than the reverse situation where ideas are attached to a priori allocation based on some distributional equity.

The Practice of Applied Behavioral Science

The above comments point to some of the characteristics of working in the area of applied research. First, it is problem oriented, hence, customer-oriented. The problem is not that of the scientist—who must consciously avoid personal projection. Listening is an admirable skill. Second, it is usually the application of known principles to pursuit of stated objectives. Seldom does one investigate the basic nature of the mechanism or dynamics with which one is dealing. Third, since the problem is presented from the so-called real world and the answers by and large known, the basic skill involved is articulation of the appropriate questions. Fourth, since the problems and question refuse to conform to disciplinary lines, one must develop a multi-disciplinary capacity to perform. This does not mean that to be successful the worker must be all things unto all people. It does mean a knowledge of the lexicon of disciplines beyond his own specialty. The economist must be able to converse with the lawyer, tht sociologist, the psychologist, in a meaningul way and with a minimum of semantic hangups. This not only takes time; it takes patience, because

FIRST AWARD PAPER IN THE UNDERGRADUATE STUDENT ESSAY CONTEST

Consumer Preference for "Imitation" Milk Beverages

ALBERT W. GUSTAFSON

> "Things are seldom what they seem,
> Skim milk masquerades as cream."
> —Gilbert & Sullivan, *H.M.S. Pinafore*

"IMITATION" milk is not new. Production records of 1916 show 6,400 metric tons of "imitation" milk processed in that year alone [13, p. 38]. However, during the past few years sales of non-dairy and partially non-dairy products have increased rapidly.

There are two broad categories of imitation milk: (1) a beverage containing non-fat milk solids with the milk fat replaced by vegetable fat (henceforth referred to as filled milk); and (2) a beverage containing no milk products (henceforth referred to as synthetic milk) [9, p. 17].

Either of the above types of milk would have adverse effects on the dairy industry should it capture a substantial part of the fluid milk market. Available data indicates that filled milk products enjoy a constant and rapid increase in sales. In the federal market order areas of the United States, filled milk sales increased from 2.4 million pounds in November of 1967 [16, p. 23] to 4.9 million pounds in April of 1969 [17, p. 24]. No comparable data is available for synthetic milk.[1]

The major problem faced by the dairy industry is the price advantage enjoyed by the "imitation" products. A recent USDA publication compared the price per one-half gallon for raw materials used in whole milk, filled milk, and synthetic milk. As shown in Table 1, the cost difference per one-half gallon between whole milk and filled milk (using Class I fluid skim milk base), was 6.5 cents per one-half gallon. The difference in cost between whole milk and synthetic was 14.2 cents, while the difference between filled milk and synthetic milk was 7.7 cents.

The best case history of filled milk sales is found in the Central Arizona marketing area. "Go," marketed by Sarival Guernsey Farms [14, p. 36], has grown from 1.3 percent of regulated pool plant (Class I) sales in October, 1966, to 11.5 percent of sales as of August, 1968 [9, p. 21].

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[1] Volume data are not available. However, in April, 1969, there were four federal order markets in which the synthetic product was being sold [17, p. 24, Table 13].

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Table 1. Comparison of estimated ingredient costs for whole, filled, and synthetic milk

Ingredient	Whole milk[b]	Filled milk: Nonfat dry milk[a]	Filled milk: Class I fluid skim milk[b]	Synthetic milk[c]
	cents			
Fluid skim milk (Class I)	15.2	—	15.2	—
Nonfat dry milk	—	9.4	—	—
Vegetable oil	—	2.7	2.7	2.7
Milk fat	12.0	—	—	—
Protein	—	—	—	5.7
Emulsifiers and stabilizers	—	2.8	2.8	2.8
Buffers, sweeteners, and body agents	—	—	—	1.8
Total	27.2	14.9[d]	20.7	13.0[d]

[a] Based on nonfat dry milk at 24.5 cents per pound, refined vegetable oil at 21 cents per pound and base mix (emulsifiers and stabilizers) at about $3 per pound.

[b] Based on the April 1968 price of $6.33 per cwt. dealers paid for 3.5 percent milk and a Class I butterfat differential of 8.0 cents.

[c] Based on soy protein costs of 37 cents per pound for protein source.

[d] Even though water composes slightly over 87 percent of the product, the cost per one-half gallon is less than .01 cent.

Source: [9, Tables 3 and 4].

In 1966 only about .02 percent of the total monthly Class I sales were filled milk in California. By August, 1968, this figure rose to 1.3 percent of total Class I sales [9, p. 21].

Without a doubt, Hawaii possesses the award for phenomenal imitation sales growth. In August, 1967, imitation sales were 0.1 percent of Class I sales; by December of the same year, imitation sales in the same market (Honolulu) had grown to 20.4 percent. This growth has tended to level off at about 20 percent of Class I sales. April, 1968, saw imitations holding 19.7 percent of the market [9, p. 21]. This unparalleled growth rate was brought about through intensive promotional activities, combined with a price differential of approximately 20 cents per one-half gallon [9, p. 21].

The Midwest has also had filled milks, but whole milk has been able to hold a large percentage of its markets because of competitive component prices.

Objective of Study

The major objective of this study is to estimate the potential impact of filled and imitation products on the dairy industry.

The ideal test would consist of acceptance of the product by the consumer under actual market conditions. However, under actual market conditions it would be impossible to hold constant all the factors that might affect purchases of the three products. The extent of advertising, retail pricing policy, and the whole assortment of marketing tools would be possible influences. Taken collectively they would have an effect on consumer purchases as well as on the product itself.

To keep the study manageable, the objective was narrowed to determining the consumers' preferences of whole milk, filled milk, or imitation milk. The use of the word preference can be justified from the standpoint that "preference accounts for 35–60 percent of the variation in consumption, . . . and . . . (it is) unlikely that any other single variable would be found effective in predicting acceptability. It has since been determined that 75 percent of the variation in acceptance of army food can be predicted from preference data . . ." [3, p. 583]. Therefore, if relative consumer preferences of the products can be determined, a large proportion of consumer acceptance will be explained. If this is true, merchandising actions may be taken to expand the sales of the product.

Procedure Used

A taste test was conducted at three grocery stores in Carbonadale, Illinois. The stores were chosen so as to obtain a cross-section of the population. One store was located on the east edge of the city, one in the center, and one on the west edge of the city.

The taste test consisted of asking the consumer to taste one ounce of each type of milk (whole, filled, and synthetic) and to register his preferences and other pertinent information on a questionnaire.

To determine relative consumer preferences for whole milk, filled milk, and synthetic milk, the Hedonic Rating Scale was utilized. The Chicago Food Acceptance Research Laboratory developed the 7-point Hedonic Scale, using the terms like and dislike. They did so with the intention of its being used with a single food stimulus by judges having no experience in food testing. The scale was first reported by Peryam and Giradot in 1952 and was later expanded into the 9-point scale [10, p. 1310].

The Hedonic scale has two essential features: (1) it assumes a continuum of preference; and (2) it causes the respondent to categorize his answer in terms of like or dislike [11, p. 11]. In relation to the first feature, the scale is more useful for determining preferences than for determining differences between samples [7, p. 6].

A copy of the scale as it appeared in the questionnaire is shown in Figure 1. Sample numbers (from a table of random digits) were recorded above each scale. The consumer then recorded his decision in the column corresponding to his cup number.

The Hedonic scale has excellent analytical characteristics. The results are similar whether one uses integers or the true scale values [11, p. 9],

Figure 1. Nine-point Hedonic rating scale

No.__________	No.__________	No.__________
Like	Like	Like
Extremely	Extremely	Extremely
Like	Like	Like
Very Much	Very Much	Very Much
Like	Like	Like
Moderately	Moderately	Moderately
Like	Like	Like
Slightly	Slightly	Slightly
Neither Like	Neither Like	Neither Like
Nor Dislike	Nor Dislike	Nor Dislike
Dislike	Dislike	Dislike
Slightly	Slightly	Slightly
Dislike	Dislike	Dislike
Moderately	Moderately	Moderately
Dislike	Dislike	Dislike
Very Much	Very Much	Very Much
Dislike	Dislike	Dislike
Extremely	Extremely	Extremely

which means that all modern statistical techniques can be used during analysis.

The reliability (reproducibility of results) of the scale is excellent. Quoting Peryam and Pilgrim, "Good reproducibility, well within statistically estimated limits, is usually found when the same food items have been tested repeatedly under the same conditions" [11, p. 11].

The Merck method was used for data analysis. The method involves calculating the fiducial limits for the control sample. This is a statistical method for determining whether or not the panels' average scores for the test samples are significantly different from the average score of the control sample. The fiducial limits represent a range of average scores (above and below average score for the control) within which an average score for a particular sample is *not* significantly different from the control. Average scores above or below the fiducial limits *are* significantly different from the control sample [7, p. 13].

Rank order relationships were used to determine the significance of preferences regarding the ranking of the whole, filled, and synthetic milks. Kendall's coefficient of concordance was used to determine the general agreement existing among consumers in their rankings of the three products. The F test was used to determine whether a significant concordance exists. If the observed F was larger than the tabulated F value, then, statistically, the ranks showed agreement.

Analysis of Data

The null hypotheses were stated as follows: $H_0 1$: There is no difference between whole milk scores and filled milk scores. $H_0 2$: There is no difference between whole milk scores and synthetic milk scores. $H_0 3$: There is no difference between filled milk scores and synthetic milk scores.

The Hedonic Rating Scale was given values from 1 (like extremely) to 9 (dislike extremely). The mean rating for whole milk was 3.18. The mean rating for filled milk was 2.90, while the mean rating for synthetic milk was 6.07. (See Figure 1 for description of numerical levels.)

Using the Merck method of analysis, at the 5 percent level of significance, whole milk scores were not significantly different from filled milk scores. However, synthetic milk scores were significantly different at the 5 percent level when compared with both whole and filled milk. In the eyes of the consumers, there was no measurable preference for either filled or whole milk.

The *F* test revealed that there was a statistical significance among the 140 consumers' rankings. The coefficient of concordance was calculated to be .877 revealing a high level of concordance. The analysis acknowledged a high degree of agreement among consumers with respect to ranking of the three beverages.

The rankings appear in Table 2. It is important to note that 63 consumers (45 percent) ranked filled milk above whole milk. Thirty-eight consumers (27 percent) placed filled milk and whole milk equally, while 36 consumers (slightly over 25 percent) ranked whole milk above filled milk. Also important is the fact that 99 consumers (approximately 71 percent) ranked synthetic milk last, while only 20 consumers (14 percent) ranked it first.

Summary and Conclusion

On the basis of consumer preference, filled milk has the capability to compete with whole milk. However, the success of filled milk in capturing part of the fluid milk market depends on the extent of merchandising used by the milk industry and the manufacturers of the filled milk product.

Schwartz stated that the "consumers' main criteria for acceptability will be taste" [2, p. 14]. However, he also concluded that what was needed for successfully marketing a filled milk product was a "creative merchandising policy—stressing perceived positives. Hetrick stated that much of the failure of filled milk to make market inroads in the Midwest was due to "the lack of consumer awareness of the product after 13 months of exposure . . ." [4, p. 2].

Table 2. Number and percent of consumers ranking milk products in various ways

Order of rankings[a]			Consumers	
1st	2nd	3rd	Number	Percent
W	F	S	23	16.43
W	S	F	4	2.85
F	W	S	45	32.14
F	S	W	2	1.43
S	W	F	6	4.28
S	F	W	7	5.00
1st	2nd[b]			
F and W	S		31	22.14
S	F and W		7	5.00
W and S	F		—	—
F	W and S		6	4.28
F and S	W		3	2.14
W	F and S		3	2.14
1st[c]				
W, F, and S			3	2.14
Total			140	99.97[d]

[a] W is whole milk, F is filled milk, and S is synthetic milk.
[b] The rankings were shortened to 2 because of ties in ranking.
[c] This category includes consumers who were unable to express any preference among the three products.
[d] Total does not add up to 100 percent due to rounding.

Both Hetrick [4, p. 5] and Schwartz [12, p. 14] state that flavor and merchandising policies are important to filled milk success. Based on the result of this study, it is the contention of this author that the key to the success of filled milk has become the merchandising policy alone, because there is no significant difference in preferences for filled milk and whole milk.

This study has concluded only, on the basis of taste, that there appears to be no difference in preference for whole milk or filled milk. However, consumers do have a preference for filled and whole milk over synthetic milk. Based on the current milk pricing plan, filled milk has a definite cost advantage over whole milk. If the aforementioned advertising and merchandising policy is applied in the sale of filled milk, the fluid milk market may be in trouble.

It seems that some adjustments may be called for in milk pricing to meet the price advantage held by vegetable fat. One possibility is to lower the fat differential for milk fat. Another more extreme alternative is to price milk as a beverage with no differential paid on butterfat.

The filled milk potential may also have an effect on the nonfat milk solids market. As noted in Table 1, if nonfat dry milk is used in the production of filled milk, an additional 5.8 cents advantage of filled milk over whole milk is attainable. A recent USDA recommended decision states, "Reconstituted skim milk in filled milk disposed of for fluid consumption should be treated as Class I milk" [18, p. 6].

It appears, then, that changes in pricing of milk solids may be used to combat the threat of filled milk. However, if the synthetic milk should eliminate some of the apparent taste problems noted by consumers in this study, the fluid milk market may be in for additional problems.

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AMERICAN
AGRICULTURAL ECONOMICS ASSOCIATION
REPORTS AND MINUTES
1968–69

REPORT OF THE PRESIDENT

Your outgoing Executive Board is the first to operate under the new form of organization developed in the administration of Lawrence Witt and tooled during Ed Bishop's term of office. The membership of the Association is now represented more broadly on the Executive Board, and continuity is provided by electing directors for three-year terms.

Many of the activities that have commanded our attention during the last 12 months were initiated by the enterprising officers who preceded us. It has been our good fortune to move forward on several important fronts. Ranking high is the project for retrieval of literature, guided by Fred Abel and his committee. The Economic Research Service and Statistical Reporting Service are providing assistance whereby the National Agricultural Library will soon begin to produce tapes of bibliographic documentation of current publications in agricultural economics. The AAEA will then convert the tape to a printed publication for distribution. Moreover, the Library's computerized record will thereupon be available for literature retrieval.

This service only codes and retrieves titles. The exciting prospect seen for the future is electronic reproduction of the sources themselves. How soon will we be able to dial a number and have the pages of a book or report flash on a screen before us? I have asked Fred Abel's group to stay in touch with developments and keep us informed.

In the same broad category is the work to commission a series of review articles for publication in special issues of the Journal. Solid progress is being recorded and much credit is due Lee Martin and his co-workers.

One of the principles now built into our organization, thanks to Witt, Learn, and Harl, is to pull our various activities into more closely knit groups. One such area of work, titled professional activities, is headed by Jim Hildreth. As an example of thinking and planning that have been going on, Ron Aines and his industry committee are looking into the possibility of professional interchange between industry and universities or government. Several other proposals for professional action will become an operating reality in the Hathaway administration.

Likewise, more than before, all awards activities are being directed by an awards chairman, who this past year has been Emery Castle. He and his subchairmen (Schuh, Eicher, Nelson, Timm, and Pulver) conduct one of the significant undertakings of the AAEA. It is worth noting that the awards committees took special pains to be sure that various areas of research or extension would be equally eligible for award.

Among unsung heroes of our organization are the members of the student affairs committee chaired by Ken Boggs. The undergraduate student program is an action program and it demands time and effort from the committee. Our gratitude is owed. In addition, Neil Harl and Ray Beneke have worked with Boggs in setting up more formal organization for undergraduate activities.

Another time-consuming program is that of contributed papers. Milton Manuel and his associates did the fine job that has come to be expected. Participation has been excellent.

We must note the dedicated service that Del Kearl has given our organization for 10 years. The editor, Varden Fuller, and his assistants and the editorial council are vital to our organization. Out of personal gratitude but on behalf of the Association as well, I record my thanks to the hosts last winter and this summer, Gene Hamilton and John Redman and their associates.

Joe Ackerman dare not be left anonymous in these credits. He has been a sturdy pillar for many years. This year he was chairman of both the fellows election committee and the joint ASA-AAEA statistical committee. In the latter regard, we have taken steps to make the statistical committee a more active one. In few subjects have agricultural economists a deeper interest than in preserving a flow of reliable statistics of agriculture and of the economy. Henceforth, the statistical committee will involve itself more actively than in the past.

Vernon Ruttan has brought imaginative thinking to our international field. Dick McConnen headed a useful study of our employment service.

More important than spotlighting activities of the past is to suggest ideas for policy for the future. My final presidential letter presents four suggestions, which for the record are to continue such a letter and move to it some of the miscellaneous notes of passing interest now carried in the Journal; to keep an open mind on the best mission of the Journal; to express ourselves in the political sphere on matters of direct concern to us; and to end the appearance of democracy without the substance that characterizes our present method of selecting the president-elect of our Association.

To these I add just a couple. On few subjects do our members, diverse though they be, have a more common interest than in the statistical base for our discipline. Having charged the statistics committee with more responsibility, I urge that the Association address itself more forcefully to the subject.

As we grow in size and comprehensiveness, we must reconsider our best mission and *modus operandi*. Whether we are concerned for the content of the Journal, the composition of our annual program, or the activities we carry on throughout the year, in all cases we must face the fact that there is a finite limit on what we can undertake directly on behalf of our membership but infinite possibilities on what we can aid, facilitate, encourage, and support. We can sponsor or co-sponsor, we can serve as common meeting ground, we can be catalyst one time and crucible the next. As illustrative examples, we could sponsor a teaching symposium or bring teachers of one subject area together to consider problems of texts or other teaching materials or even to thresh over issues in subject matter content. We could set up a session on the relation of the agribusiness and academic parts of our profession.

Finally, I dare to advise that our leaders must ever strive for a balance between meeting the particular needs of our specialty sub-groups and cultivating the area of our common interests. I am as sensitive as anyone, I believe, to the interests of our several constituencies, but I also believe there must be and is a common denominator; and it is something to be maximized. To change the figure, we must avoid divisiveness and parochialism.

I am grateful for the opportunity you gave me to serve as your president.

Respectfully submitted,
HAROLD F. BREIMYER

RESOLUTION

The University of Kentucky, its president, and the faculty and staff of the Department of Agricultural Economics have shown much hospitality to the members of the American Agricultural Economics Association, their families and guests, and to the AAEA officials and related groups at the Annual Meeting held at Lexington, Kentucky, August 17-20, 1969. *Therefore:*

Be it resolved that the American Agricultural Economics Association express its sincere gratitude to President Otis Singletary and to the faculty and staff of the Department of Agricultural Economics and their wives for their hospitality. All these, under the leadership of John Redman, Bob Rudd, and Milt Shuffett of the Local Arrangements Committee, have served us efficiently and graciously. The Association wishes to acknowledge the individual effort of Miss Gertrude Hanly for her art display on the cover of the program, the materials packet, and elsewhere.

Be it further resolved that a copy of this resolution be sent to President Singletary, to Dr. Redman, to each of his subcommittee chairmen, to Miss Hanly, and to others at the University of Kentucky as appropriate.

REPORT OF THE SECRETARY-TREASURER

In 1968 there were 4,117 individual members of the American Agricultural Economics Association (Table 1). This compares with 4,141 individual members for the previous year. Although the number of regular members was up slightly, other categories of individual membership were down in 1968. The decrease in the total number of individual memberships was the first to occur since 1952.

By contrast, there were 38 sustaining members in 1968 and 29 in 1967. The subscriptions, too, were up with 1,618 in 1968 and 1,481 in 1967. Two-thirds of the increase was in foreign subscriptions.

Table 1. American Agricultural Economics Association: number of members and subscribers, 1968

Category	Number
Sustaining members	38
Regular members—United States	2,716
Foreign	547
Junior members—United States	585
Foreign	82
Corresponding members	187
Libraries and businesses—United States	594
Foreign	1,024
Exchange	3
Number of copies AJAE	5,776

Financially too, this report is not as favorable as it should be. In 1968 the Association had an operating loss of $7,479.09 (Table 2). Since this report is

Table 2. American Agricultural Economics Association: income and expense statement for year ending December 31, 1968

Income			
Dues and subscriptions:			
Regular members		$25,913.66	
Joint members		8,765.50	
Junior members		3,181.50	
Subscriptions		15,931.18	
Corresponding members		2,457.00	
Sustaining members		3,900.00	
			$60,148.84
Less: Decrease in FS Sub. Pay	$ 81.00		
Refunds and NSF checks	252.80		
Increase in prepaid dues	365.50		
			699.30
			$59,449.54
Annual meetings			1,274.58
Dividends and interest			6,726.36
Back issues			5,692.46
Reprints			3,565.01
Advertisements			737.75
Miscellaneous			1,051.38
Total			$78,497.08
Expense			
Journal printing (including $19,511.92 for December AJAE)			$50,577.87
Swanson—Editor's expense			713.37
Swanson—Editorial assistant			4,223.15
Fuller—Transfer office			413.19
Fuller—Payment to Univ. of California			3,000.00
Fuller—Editorial expense			300.00
Printing reprints			2,429.99
Purchase back issues			1,079.00
Postage and wires			1,328.21
Office supplies and stationery			1,052.97
Annual meetings			2,925.20
Committees			6,554.68
Joint dues:			
Collected	2,773.60		
Remitted and charges	2,795.53		
			21.93
Bond			140.00
Reorganization expense			432.99
Audit			200.00
Secretary-Treasurer: Honorarium			3,000.00
Secretary			4,875.88
Other help			2,244.13
IBM machine usage			147.50
Miscellaneous			316.11
Total			$85,976.17
Net operating loss			7,479.09

the first to be made on a calendar year it is not possible to make comparisons with previous experience for a directly comparable period. However, the income for calendar (and fiscal) year 1968 was $78,497.08, or $2,271.24 above that for the July 1, 1966 to June 30, 1967 period.

Expenses for 1968, on the other hand, were $85,976.17, or $18,060.05 higher; and, whereas the Association showed a gain of $8,309.72 in the 1966-67 period, there was the substantial loss noted above in calendar 1968.

The biggest difference between the periods was a $9,091.25 higher Journal printing bill. Part of this was because of increased printing rates but also part was because of the larger number of pages printed.

Yet another item that added to the high expenses for 1968 was the overlap of editors during the last half of the year. The support of these two offices, even though the "old" editor was phasing out and had reduced expenses, resulted in the outlay for that activity of AAEA being $5,280.55 more in 1968 than in the earlier period.

Also, whereas the past policy of the Association has been not to pay travel expenses for its committees, there has been some bending of this policy and the committee expense in 1968 was above that for the earlier period. In 1968 the committee expenditures were $6,554.68 (Table 3). This includes the awards program activities.

Table 3. American Agricultural Economics Association: committee expenditures, 1968

Membership—Postage, printing, etc.	$ 52.26
Fellows—Travel	190.56
Retrieval of Literature—Travel	1,036.24
Sustaining Membership—Postage, printing, etc.	32.63
Review of Postwar Work in Agricultural Economics—Travel	1,205.29
Awards—Postage, printing, etc.	149.55
Research Awards	2,050.02
Teaching Awards	250.00
Extension Awards	500.00
Undergraduate Affairs—Postage, printing, etc.	288.13
Honoraria	200.00
Awards	600.00
Total	$6,554.68

Higher wages and higher stationery and supply bills—just plain higher cost of living—also added to the deficit.

Obviously, the Association cannot continue to operate with a net loss, and action must be taken to correct the situation.

There is little hope that great reductions can be made in our operating costs. Future printing bills are likely to continue to be high, because printing costs will not go down and probably will go even higher. Some savings in connection with the editor's office will come next year because we will not have a "double" editor expense. However, costs of operating the office of editor and secretary-treasurer will go up as wages and prices increase and as the volume of business done by those offices increases. The committee expense can increase or decrease, depending on how the Executive Board "bends" or alters the Association policy.

All of this means that costs are going to continue to be high. They may not be as high as they were in 1968 but they will be high. The editor may be instructed to print smaller volumes of the *AJAE*, committee expenses may not be authorized, and/or less support may be authorized for the editor and secretary-treasurer. These and other actions may be taken to reduce our operating costs.

To help on the other side of the account, we can make efforts to increase our income. As mentioned earlier, we had a decrease in 1968 in individual memberships in the Association. Over the previous 16 years the average increase has been 157 members per year. One way of meeting our rising expenses is to have a continued growth in membership.

If the expenses cannot be controlled sufficiently or if income from the growth in memberships is not great enough, the Association will be forced to increase its dues rates. These are among the lowest for professional associations and have been increased only $1.00 since 1958. During this time we have expanded our activities, and our costs of all operations have gone up. The printing bill for the *JFE* in 1958 was $27,078.74, as contrasted with this year's bill of $50,577.87 for the *AJAE*.

The Association is not bankrupt. The net worth, with investments at cost, was $51,351.11 at the end of the year (Table 4). With stocks and bonds at market value, the Association's net worth was about $144,932. However, $50,000 of this has been committed for the initial support of the Agricultural Economics Documentation Center.

Table 4. American Agricultural Economics Association: balance sheet, December 31, 1968

Assets			
Cash			$ 1,658.26
Dividends to be remitted by E. F. Hutton Co.			171.90
Advance—Ann. meetings, Montana State University			1,000.00
Expenses advance—Fuller—AJAE editor			300.00
Franklin Square account receivable			567.00
Investments (at cost)—			
Corporation bonds		$22,936.91	
Listed stocks		64,627.98	
(Market value approximately $181,147)			87,564.89
Total			$91,262.05
Liabilities			
Editor's assistance payable			$ 145.00
Editor's postage payable			13.20
Editor's travel payable			274.21
Due Cornell for secretarial assistance			4,931.61
Prepaid membership dues			14,922.00
IRS Taxes due			113.00
Printing cost of December AJAE			19,511.92
			$39,910.94
Net Worth			
Balance December 31, 1967	$58,830.20		
Plus: Net operating loss	7,479.09		
Balance December 31, 1968			$51,351.11
Total			$91,262.05

The Association is sound financially because of its endowment fund but steps must be taken to bring expenses and income in balance if it is to continue to have this sound financial status.

Respectfully presented,
C. D. KEARL, *Secretary-Treasurer*

AUDIT REPORT

Dr. Harold F. Breimyer, President
American Agricultural Economics Association
200 Mumford Hall
University of Missouri
Columbia, Missouri 65201

Dear Harold:

As you requested in your letter of November 5, we conducted the annual audit of AAEA recently. Dr. C. W. Loomis was kind enough to serve on the committee with me.

We have examined the financial records of the American Agricultural Economics Association as of December 31, 1968.

As a part of this examination, we selectively reviewed income and expenses for the fiscal year, inspected the checking account, confirmed the reported inventory of the securities held by the Association, and randomly tested the record of membership against payment of dues. Related aspects of the financial affairs of the Association also were reviewed.

We found the financial records to be correct and to fairly represent the financial position of the Association on December 31, 1968.

Sincerely,
DANA C. GOODRICH, JR.
Associate Professor of Marketing
Cornell University

REPORT OF THE INVESTMENT COMMITTEE

There were no changes during 1968 in the stock and bond holdings of the American Agricultural Economics Association. The stocks, however, moved up in market value by almost $20,000 (Table 1).

The dividends for the year, $5,480.49, amounted to a return of 3.8 percent on the value of the stocks at the beginning of the year. The bonds returned $1,112.54 in interest and this, on the value at the beginning of the year, was a return of 6.0 percent. Short-term investment of operating funds brought the Association $133.33.

Not all of the stocks showed increases in market value (Table 2). The Borden and General Electric declined. Chase Manhattan Bank, Clark Equipment, Continental Can and Jewel Co. showed the greatest relative market advances of those held by the Association.

The highest dividend rates were paid by American Tel. and Tel., Clark Equipment, Commonwealth Edison Co., Continental Can, Jewel Co., and Standard Oil, New Jersey.

Bonds provide a stable return on the investment but fall in value as interest rates increase. During the year the AAEA bonds provided $1,112.54 of income but declined in market value by about $625 (Table 3).

Table 1. American Agricultural Economics Association: summary of investments, December 31, 1968

Item	Income January 1 through December 31, 1968	Value	
		Cost	Market
Stocks			
On hand January 1, 1968		$64,627.98	$143,860.75
Change during year			
On hand December 31, 1968		64,627.98	163,106.12
Dividends received	$5,480.49		
Corporation Bonds			
On hand January 1, 1968		22,936.91	18,666.25
Change during year			
On hand December 31, 1968		22,936.91	18,040.00
Interest received	1,112.54		
Certificates of Deposit			
(Tompkins County Trust)			
Interest received	133.33		

Table 2. American Agricultural Economics Association: stocks, December 31, 1968

Company*	Inventory 12/31/68		Dividends received	Market value	
	Number of shares	Original cost	1/1/68 through 12/31/68	12/31/67	12/31/68
Am. Tel. & Tel. (A+)	288	$11,421.11	$ 691.20	$ 14,508.00	$ 15,336.00
Borden Company (A+)	228	2,162.41	273.60	8,008.50	7,951.50
Chase Manhattan Bank (A+)	62	1,115.09	147.64	3,820.75	5,099.50
Clark Equipment (A−)	600	2,200.67	720.00	15,750.00	19,650.00
Comm. Edison Co. (A+)	232	7,467.14	510.40	10,904.00	11,484.00
Continental Can (B+)	150	4,315.38	307.50	7,387.50	10,275.00
General Electric (A+)	150	1,920.57	390.00	14,400.00	14,025.00
Jewel Co. (A)	100	3,875.94	167.50	3,312.50	4,950.00
Owens-Ill., Inc. (A)	140	2,925.35	189.00	8,050.00	10,080.00
Sears, Roebuck (A+)	304	1,845.38	395.20	17,442.00	18,924.00
Std. Oil, Indiana (A)	400	7,356.68	840.00	21,650.00	24,800.00
Std. Oil, N.J. (A+)	153	10,325.36	558.45	10,327.50	12,106.12
Texaco (A+)	100	7,696.90	290.00	8,300.00	8,425.00
Total		$64,627.98	$5,480.49	$143,850.75	$163,106.12

* Standard and Poor's rating for earnings and dividends shown in parentheses.

Table 3. **American Agricultural Economics Association: corporation bonds, December 31, 1968**

Item	12/31/68		Interest	Maturity	
	Inventory (at cost)	Market value	1/1/68 through 12/31/68	Value	Date
Am. Tel & Tel.	$ 5,046.91	$ 3,925.00	$ 256.26	$ 5,000.00	4/1/01
Iowa Ill. Gas & Elec.	5,200.00	3,900.00	243.78	5,000.00	5/1/91
Pacific Tel. & Tel.	10,650.00	8,575.00	512.50	10,000.00	2/1/93
Witco Chemical Co.	2,040.00	1,640.00	100.00	2,000.00	6/1/80
Total	$22,936.91	$18,040.00	$1,112.54	$22,000.00	

Overall, the investments provided $6,726.36 in cash dividends and interest to help finance the various Association activities.

Prepared by C. D. KEARL
for the committee

REPORT OF THE EDITOR

In the year ending June 30, 1969, new manuscript submissions were 268. This is up 30 percent from the previous 3-year average. My immediate predecessors, Earl Swanson and James Nielson, reported acceptance rates of 44 and 46 percent, respectively. It is too early to know if so high an acceptance rate can be maintained with respect to a higher level of submissions.

I believe it is worthwhile that our members be aware of a few details on the JOURNAL's magnitudes and how they come about. Most JOURNAL-watchers will know that the papers emerging from the winter and annual meeting programs are not refereed and that the acceptance rate is automatically 100 percent. Parenthetically, it should be noted that the proceedings papers are not included in the calculation of the acceptance rates. The Editor's only role with respect to the aggregate magnitude of the proceedings papers is to join the President in prescribing and exhorting conciseness on the part of the participants he invites.

As an average for 1960-1968, the Proceedings of the Annual Meeting (December issues), including the program and Association reports, have taken up 40 percent of the JOURNAL's total pages. Winter proceedings papers (carried in the May issue) have taken 7 percent. The remainder, 53 percent, has been the Editor's nominal province for refereed articles, communications, news notes, and announcements. Since the line of admonishment to constrain the printing bill usually runs from President to Editor and not vice versa, there may be a moral somewhere in these percentages.

A few supporting and related statistics on the JOURNAL's magnitudes, 1960-1968, are given in Table 1. These figures do not suggest much in the way of trends or consistent patterns. I find the low correlation between pages and items somewhat surprising. One notes that in 1960, 1,653 pages were enough to handle 191 items, whereas in 1968 it took 1,836 pages for 193 items. Does this imply creeping verbosity? Several other couplets can be picked from the series that seem to support this implication.

Table 1. Pages and items published by *AJAE* (*JFE*), 1960-1968

Year	Pages of edited papers[a]	Pages of proceedings papers[b]			Journal, total pages	Number of items[c]
		Winter meeting	Annual meeting	Total		
1960	775	93	595	688	1,563	191
1961	863	143	589	732	1,595	219
1962	1,071	173	683	756	1,827	222
1963	811	127	629	756	1,567	209
1964	846	68	559	627	1,473	166
1965	964	114	569	683	1,647	167
1966	919	157	684	841	1,760	205
1967	915	83	642	725	1,640	191
1968	998	102	736	838	1,836	193
Average	909	117	630	747	1,656	199
Percent	53	7	40	47	100	

[a] Includes articles, communications, book reviews, and news notes.

[b] Includes invited papers, discussions, and association reports.

[c] Edited papers and proceedings papers including communications, replies, and discussions; book reviews, news notes, and association reports are not included.

Creeping or not, I believe we are afflicted with verbosity and that we can get better mileage from our printed pages. My persuasion to this view comes mainly from the reviewers of manuscripts who so characteristically recommend reduction by eliminating unnecessary material and editing for concise communication and from not too fruitful experience in trying to persuade authors to do as reviewers recommend.

In the August issue, we introduced a *Research Notes* section that we hope will help to promote more effective use of our printed pages. The same issue has an Editor's *Communication* that explains the purposes of *Research Notes*; also, it explains the economy we have attained in *News Notes*.

A rigid length limitation on manuscripts that are to be refereed is undesirable, I believe. Yet, since the JOURNAL is truly a participatory enterprise in terms of both magnitude and quality, it seems proper to suggest that contributors should ask themselves the counterpart of the erstwhile wartime question: "Is this trip really necessary?" This question could apply to the whole paper as well as its components.

I have the pleasure of announcing that Gerald Dean has become Associate Editor to serve concurrently with Harold Carter and myself.

The devotion and geniality of staff associates and Editorial Council are noted with much gratitude. With no less gratitude and with some wonderment of their unselfishness, I acknowledge the immeasurably significant contribution of countless manuscript reviewers whose compensation is principally the privilege of electing anonymity. The reason for saying "countless" is that many reviewers note that they have consulted colleagues, but they do not always say how many.

VARDEN FULLER, *Editor*

MEMBERSHIP COMMITTEE REPORT

Members of the committee include Quentin M. West, Chairman; Fred H. Wiegmann; T. T. Williams; Charles R. Pugh; LaVon S. Fife; N. Keith Roberts and Del Mar Kearl. We were a little late in getting under way due in part to the necessity of forming a new complete committee and the chairman's foreign travel during the latter part of 1968. After contacting former chairmen to learn what activities had been successful in the past and receiving suggestions from other members of the Membership Committee, the chairman met with Del Kearl in February to draw up a plan of action.

Responsibility was divided as follows:

West—Agricultural economists in the Federal government and foreign members.

Fife—Agricultural economists in business and industry.

Roberts—Agricultural economists in colleges and universities in the western states.

Pugh—Agricultural economists in colleges and universities in the north central states.

Wiegmann—Agricultural economists in colleges and universities in the eastern states.

Williams—Agricultural economists in colleges and universities in the southern states.

Each member of the committee was to write the chairman of the agricultural economics department of each land-grant university and request the following assistance in membership activities:

a. Appoint a staff member, or himself, as University contact for AAEA membership drive. If the Extension Service is separate, ask him to propose a contact in the Extension Service.
b. Request this Membership Contact to determine who are members among the faculty and graduate students and who are not. Ask him to give nonmembers a copy of a letter from President Breimyer outlining the advantages of membership in the AAEA and give them an application form.
c. Ask that a notice about AAEA membership, and where to send dues, be put in the Department's News Notes which are sent annually to alumni.
d. If the Department does not have News Notes, ask about their willingness to circulate information among their alumni about AAEA membership.
e. Encourage establishment of Junior AAEA chapters at the universities.
f. Request a list of other colleges or universities in the state which are giving degrees in agricultural economics.
g. Request information on chapters of agricultural clubs similar to those in the Chicago and San Francisco areas. Send this information to Fife.

Upon obtaining information on other colleges and universities that give degrees in agricultural economics, they were to write these institutions with similar requests.

They have been requested to write each of these university membership contacts in September 1969 repeating much of the above requests but asking that a special effort be made with incoming graduate students.

All members of the committee made the contacts as requested. Apparently, they have received cooperation. Administrators and division directors in the Federal government were very cooperative in passing this information on to their agricultural economist colleagues.

There were some suggestions for stimulating membership that would require action by the Executive Committee. The Chairman submitted these to President Breimyer, and these are listed for your consideration:

a. There is no provision for undergraduate students being affiliated with the Association, yet there is some participation at the annual meetings in the form of student debates. If these students could be affiliated during their junior or senior years, we think it would be conducive to continue membership, especially for those who do not go beyond their B.S. degree. Therefore, we propose a Student Membership (differing from the Junior Membership) with a fee of $2.00. This would entitle them to a membership card, AAEA notices, and one subscription to the Journal for each 10 student members. Local chapters may be organized which may, or may not, be tied to the Junior Chapters where they now exist.
b. A student section in the JOURNAL for graduate student contributions may encourage activity of our junior members.
c. The handbook has always been an inducement for membership. It might be helpful if this were updated annually by including, in one issue of the JOURNAL, similar information on new members.
d. It might ease the load of the annual membership drive if members were encouraged to pay dues for two or three years with a small reduction in cost.

Other activities by the Membership Committee are as follows:
a. The secretary sent a note to the heads of departments in September regarding junior members and a supply of application forms.
b. A dues reminder was included in the secretary's letter to all members in November.
c. Dues notices were sent out in January.
d. In July the chairman and the secretary sent a letter of encouragement to all delinquent members.

The time is too short to determine if the efforts of the Membership Committee will be successful. As of July 1969, we had 150 fewer members than at the end of 1968. (678 delinquent members were cut off on that date.) All of this net loss was in junior members and foreign members. Regular U.S. members have increased slightly. The number of junior members has been decreasing since 1967. I am not sure whether this is indicative of less interest on the part of graduate students or fewer graduate students in agricultural economics.

The number of foreign members has decreased somewhat in total, but more important is the percentage turnover. Thirty percent of the delinquent members as of July 1969 were foreign members, and this represented 37 percent of the foreign membership; 63 percent of the delinquent institutions were also in foreign countries.

A large part of the foreign membership results from the practice of the Agency of International Development to finance three-year memberships in a professional organization for each of the trainees who come to the United States. At the end of the three years, a large part do not continue membership. I have discussed this problem with representatives of other professional associations and they have had the same experience. Ten dollars represents a lot of money for most young foreign economists, and it is very difficult in many countries to obtain U.S. dollars. What action should be taken depends to a large extent on how interested AAEA is in maintaining foreign members. Should they be given a discount that would just cover the marginal cost of supplying them with the JOURNAL? One possibility is to allow them to pay for membership with

UN chits which can be purchased at the local UN Office; then AAEA could redeem them at the UN Office in New York.

QUENTIN M. WEST, *Chairman*

REPORT OF THE SUSTAINING MEMBERSHIP COMMITTEE

There are now 45 Sustaining Members of AAEA for 1969. The members of the Sustaining Membership Committee have been helpful and cooperative. This is much appreciated.

The 1969 Sustaining Members are:

Agway, Inc.
Allied Mills, Inc.
American Dry Milk Inst., Inc.
Beatrice Foods Co.
Board of Trade of the City of Chicago
Brown & Williamson Tobacco Corp.
Campbell Soup Co.
Cargill Incorporated
Central National Bank in Chicago
Central Soya Company, Inc.
Chicago Mercantile Exchange
Continental Grain Company
Cotton Producers Association
Dairymen's League Coop. Assn., Inc.
Deere & Company
Doane Agricultural Service, Inc.
Eastern Milk Producers Corp. Assn., Inc.
Farm Journal, Inc.
Farmers Union Central Exchange
Farmland Industries, Inc.
F. S. Services, Inc.
Geo. A. Hormel & Co.
Green Giant Co.
The Harvest Publishing Co.
H. P. Hood & Sons, Inc.
Indiana Farm Bureau Coop. Assn.
International Harvester Co.
The Kroger Company
Land O'Lakes Creameries, Inc.
Merck & Co., Inc.
Kraft Food Division
Northwestern Mutual Life Ins. Co.
Oscar Mayer & Co.
Peavey Company
Pioneer Hi-Bred Corn Co.
The Progressive Farmer
Ralston Purina Company
Register & Tribune
Safeway Stores, Incorporated
Soy-Cot Sales, Inc.
Staple Cotton Coop. Assn.
The Travelers Ins. Company
Weitz-Hettelsater Engineers
Wilson & Co., Inc.

C. D. KEARL, *Chairman*

REPORT OF THE INDUSTRY COMMITTEE

The Industry Committee has carried on three major activities during the year: (1) planned for the annual industry dinner; (2) worked with the newly created Professional Activities Committee; and (3) evaluated alternative types of exchange activities that the Association could sponsor to increase beneficial interchange between industry and nonindustry economists.

Plans are complete for the Sixth Annual Industry Dinner to be held as part of the annual AAEA meetings at Lexington, Kentucky. Robert Eggert, Staff Vice President of Economic Research for RCA is to present a paper, "Business Searches for Relevant Economic Inputs." The dinner is being publicized in trade publications to encourage more industry economists to attend and join AAEA.

The chairman of the Industry Committee, by virtue of this position, is a member of the newly created Professional Activities Committee and has attended its meetings; and the committees have worked together on questions such as interchange and recruitment.

The subject of increased interchange divides itself into two major parts: (I) types of exchange activities that are feasible; and (II) how the AAEA could implement increased exchange. The need for this evaluation arises from the tendency for industry economists and the remainder of the agricultural economics profession to become isolated from each other. Yet agribusiness is a major customer for the output of the profession in the form of data, analysis, projections and trained people. Increased interchange should help improve the product and customer relations.

I. Types of Feasible Exchange Activities

Following considerable discussion and evaluation the realistic opportunities for increased exchange between industry and nonindustry economists seem to be:

1. workshops
2. seminars
3. visiting lecturers, speakers, consultants
4. sabbatical leave exchange
5. advisory planning committees that emphasize the future planning function (not review) for research and training programs
6. membership on graduate committees.

II. How the AAEA Could Implement Increased Exchange

1. Workshops, forums, or seminars (1 to 3 days in length) that include a good mix of industry and nonindustry economists on a "pertinent major macroeconomic issue," have been suggested from several sources. The AAEA could set up one or more a year at the USDA, an adjustment center, or a company location.
2. The AAEA could develop a list of industry economists who are interested and available for seminars or as visiting lecturers. This could include both active and retired industry economists.
3. Good programs that outstanding agricultural economics departments or industry research divisions already have in existence that result in good interchange between industry and nonindustry economists could be systematically identified and publicized to other departments and throughout the profession.
4. Research and training advisory planning committees could be organized by the Association, one for each region of the country, to include an appropriate mix of industry and nonindustry economists to work with government, academic, and industry departments in the future planning function for research and training programs.

The committee has developed a highly imperfect list of AAEA member industry economists. When another survey of agricultural economists is made for an updating of the Association Handbook (updating is needed now), the committee would like to cooperate to develop a better list of industry economists. Such a list is valuable for research and identification of professional needs and as a service function to the Association officers and the Industry Committee in soliciting assistance in Association activities.

R. O. AINES, *Chairman*

THE REPORT OF THE AWARDS COMMITTEE

This is the second year that the AAEA awards have been coordinated by one chairman. While I am not fully informed regarding operation of the program under the earlier arrangement, I believe the present system is working reasonably well. A consolidated announcement and uniform types of recognition have obvious advantages. The following items characterize the current year's experience:

1. In some categories there was a substantially larger number of entries than a year ago. In the published research category there were 41 entries, compared to 19 a year ago. In the M.S. thesis contest 44 theses were judged, which was an increase from a year ago. In the Ph.D. thesis category, there were 33 entries. Entries in the teaching and extension categories were 14 and 7, respectively. The reading was certainly substantial in all of the research categories.

2. No serious problems were encountered in interpreting the rules. In two categories the entry deadline was not met. We refused to judge the late entries in both cases but suggested they might wish to consider presenting the entry to next year's subcommittee. This was suggested in the belief that the rules were formulated to assist with the judging, rather than to preclude any worthy item from being considered. In the case of one published research winner, the publication carries a 1967 publication date. However, the work did not actually see the light of day until 1968, and the entry was ruled by me to be eligible.

3. There are two serious problems pertaining to the Awards Program. These are:

   a. The number of entries in the undergraduate teaching and the extension categories. The Association may wish to consider limiting the number of extension awards to one, unless the number of entries exceeds (say) 10. In any case, these subcommittee chairmen will be encouraged to stimulate entries next year.

   b. The exceedingly heavy load of reading and complicated logistics associated with the research categories is making it increasingly difficult to be ready for these meetings. We will probably require receipt of all entries by February 15 next year. This will make it necessary to mail announcements earlier than has been the case. I recommend strongly that President-Elect Hillman select his Awards chairman and subcommittee chairmen far enough in advance of next summer's annual meeting so that they can meet during the annual meetings if they desire.

4. Question has been raised by the published research subcommittee as to whether books and long bulletins should be judged in competition with journal articles and shorter publications. We have no recommendation for change, as the arguments in favor of keeping the present system appear to be stronger than those favoring change at this time.

5. The Ph.D. subcommittee had the most difficulty in completing their judging prior to these meetings. Their suggestions are:

   a. Start the judging on February 15 rather than March 15 (referred to above).

   b. Require each university to submit three rather than two copies.

   c. Allow universities to submit one thesis for every 12 completed, instead of one for every 8. A difference of opinion exists on the subcommittee with respect to the latter recommendation, and some would prefer to increase the number of judges rather than change the ratio. The masters thesis subcommittee chairman also recommended that the ratio be changed from 1 to 12 or 15, instead of the present 1 to 8.

It appears to me that the above is a policy issue, and a decision should be made by the Executive Board. I am inclined to recommend the Ph.D. ratio remain as it is, but that the number of judges be increased to 12 instead of 6. Not only will this spread the work, but it will also permit better balance on the committee. I am also recommending that the M.S. ratio be changed from the present 1 to 8 to 1 to 12.

6. Warren Bailey has made a suggestion relative to the Ph.D. winners as well as other published research winners. It would seem this is a matter that should, at a minimum, involve the Editor and possibly the Editorial Council. As far as the Awards Committee is concerned, we would be pleased to see this added recognition and evaluation of the research. It has also been suggested that a description of the winning extension programs also be included in the Journal.

7. Carl Eicher, Ph.D. thesis subcommittee chairman, has identified what may be a potentially explosive issue. This pertains to a workable definition of "agricultural economics." The number of eligible theses from a particular institution affects the number that may be submitted. The eligibility of research, teaching, or extension activity is also involved. The matter has only recently arisen, and I have no particular recommendation to make except that the Executive Committee should give the matter immediate attention. Perhaps a special committee should be appointed to study the matter and make recommendations.

Finally, I would emphasize a point I made last year. The Awards Committee is a judging and administrative group. It is exceedingly difficult for this group to identify and evaluate policy issues connected with the Awards Program. Therefore, if the Executive Board wishes awards policy to be studied at any time, it is recommended that a separate group be appointed to do that. President Hathaway has asked that I serve an additional year as chairman, and I have agreed. However, it would be inappropriate for me to serve longer, even if President-Elect Hillman would wish for me to do so, which I doubt. Prior to serving as chairman, I was a M.S. thesis judge and subcommittee chairman for published research. In my final report to the Executive Board a year from now, I intend to prepare an evaluation of the entire Awards Program. It is apparent the program is requiring substantial resources to carry it forward. It may be helpful for someone to attempt to identify the benefits and costs, both implicit and explicit, of the present Awards Program.

Emery Castle, *Chairman*

Award Winners

Distinguished Extension Program

Gene McMurty, Virginia Polytechnic Institute
Noah S. Hadley, Purdue University

Distinguished Undergraduate Teacher

Albert H. Harrington, Washington State University

Master's Thesis

Gunn, T. C., "Econometric Analysis of Post-War Demand for Farm Labor in the Northeastern United States," University of Connecticut, 1968.

Halvorson, M. P., "The Optimum Number, Size, and Location of Turkey Processing Plants in a Three-State Area," Iowa State University, 1968.

SIMMONS, E. B., "The Food Balance Sheet as a Parameter of Tropical Food Economies: The Case of Mauritius," Cornell University, 1968.

Doctoral Thesis

LEE, TENG-HUI, "Intersectoral Capital Flows in the Economic Development of Taiwan, 1895–1960," Cornell University, under the direction of John Mellor.

LEUNIS, JOSEPH, "A Spatial Analysis of the United States Soybean Industry," University of Illinois, under the direction of George Judge.

PINEIRO, MARTIN, "The Argentine Agriculture: Past and Potential Contribution to Country-Wide Economic Growth," University of California, Davis, under the direction of Chester McCorkle.

Published Research

WEYMAN, F. HELMUT, *Dymanics of the World Cocoa Market,* The MIT Press, 1968.

HOUCK, JAMES P., AND J. S. MANN, *An Analysis of Domestic and Foreign Demand for U.S. Soybeans and Soybean Products,* Agricultural Experiment Station Technical Bulletin 256, University of Minnesota, 1968.

YOTOPOULOS, PAN A., *Allocative Efficiency in Economic Development: A Cross-Section Analysis of Epirus Farming,* Athens, 1968; Center of Planning and Economic Research; International Publications Service, New York.

Outstanding Article in the JOURNAL

SCHULTZ, T. W., "Institutions and the Rising Economic Value of Man," *Am. J. Agr. Econ.* 50:1113–1122, Dec. 1968.

REPORT OF THE STUDENT AFFAIRS COMMITTEE

This is the twenty-first year that a Student Section has operated as part of the annual meeting of this Association. This year we have 47 chartered chapters (local departmental clubs) of the Student Section. We have chartered three new clubs this year: Tuskegee Institute, the University of Nevada, and the University of Manitoba. In addition, there are several non-chartered schools usually represented at each annual meeting. We have encouraged participation and involvement of all schools offering courses in agricultural economics in the Student Section program and at our annual meetings.

The 47 chartered chapters may be classified as follows:

Canada	United States and Possessions	
Number of schools	Number of schools	
	Land-grant	4 year non-land-grant
4 Ontario Agricultural College MacDonald College University of Alberta	36	6 Texas Technological College Southern Illinois University A&T College of North Carolina Tennessee Technological University Tuskegee Institute

Typically about one-half of the chartered chapters are represented at our annual meetings and contests, with about 50 to 100 students present and participating in some way, either in the Student Section program or attending the meetings of the AAEA.

As indicated in prior annual reports, individual students have not established a continuous year to year attendance record in sufficient numbers to provide a core group about which the Student Section might function somewhat independently of the Student Affairs Committee. This has not deterred student officers at annual meetings from implementing programs which either are left uncompleted or must be kept alive and working by the Student Affairs Committee. This has been a continuing and expected fact of life for the committee, but it is a very important part of the somewhat frustrating and lonely feeling experienced by some of our student officers. The absence of funds for visible and realizable projects at the annual meetings has also added to this frustration.

As a result of action by the Student Section at Bozeman last August to assess a fee associated with a membership certificate (proposed as a prestige item at Guelph) and subsequent discovery of no specific AAEA Bylaws article pertaining directly to the Student Section, President Breimyer asked Neil Harl to chair a committee of three (Neil Harl, Ray Beneke, and Ken Boggs) to draft a proposal for an article to the AAEA Bylaws relating to Student Section activities. This proposal was presented to President Breimyer and circulated among members of the Student Affairs Committee for their comments and suggestions. Based on written comments from committee members and students, Neil Harl prepared a revised proposal. This revision, dated July 10, 1969, was recirculated to committee members and student officers prior to a meeting called for August 15, 1969, at Lexington. Six of the eight regular members and three of the four student officers were present at this meeting. Neil Harl recommended the proposal to be Article XIII of the AAEA Bylaws and to renumber the current Article XIII as Article XIV. The committee members and student officers present unanimously approved the proposed Article as presented.

Participation in these contests has tended to be fairly high. This year the number of schools represented was unchanged from 1968, but individual student participation declined. Repeat attendance by individual schools and indi-

Contest Participation*

Contest	Number of schools			Number of students		
	Land-grant	Other	Total	Land-grant	Other	Total
	1968, Montana State University, Bozeman, Montana					
Essay	12	1	13	19	2	21
Public speaking	14	1	15	30	2	32
Debate	10	2	12	20	4	24
	1969, University of Kentucky, Lexington, Kentucky					
Essay	15	1	16	24	1	25
Public speaking	7	2	9	11	2	13
Debate	9	1	10	18	2	20

* A total of 22 different colleges and universities were represented and 53 students were involved in our programs.

vidual students has been somewhat variable, depending in part on the location of the annual meetings. Some schools have consistently participated in these contests year after year—reflecting the dedicated service of our teachers and faculty to the young people of those institutions and to their Association.

The contest program has been a most successful effort. It has brought young people to the annual meeting of our professional association and offers them an opportunity to see and feel the professional nature of our chosen field. This is over and beyond the direct contribution of the contests themselves.

National Student Section Officers, 1969-1970

President—Edwin Smith, Texas A&M University
Vice-President—John Coop, Washington State University
Secretary-Treasurer—Randall Cromer, Purdue University
Editor—Bill Hand, Clemson University

1969 Student Award Winners

Essay contest

First: ALBERT W. GUSTAFSON, "Consumer Preference of 'Imitation' Milk Beverages," Southern Illinois University. Advisors: Roger Ginder and Lyle Solverson.

Second: DONALD MITCHELL, "The Economic Implications of Limiting Government Payments to U.S. Farmers: A Study of Montana Producers," Montana State University. Advisor: Richard McConnen.

Third: DAVID O. GRIFFIN, "The Effects of a Cigarette Tax in North Carolina," North Carolina State University. Advisor: Richard K. Perrin.

Fourth: RICHARD NOYES, "Use of Business Analysis Factors as Criteria for Extending Agricultural Credit," South Dakota State University. Advisor: Robert Beck.

Fifth: FRANCIS H. LEUKEN, JR., "The Application of Large-Scale Programming to Coordination of the Pork Industry." Purdue University. Advisor: Gordon D. Honnegger.

Public speaking contest

First: WILLIAM T. BOEHM, "Consider the Countryside and Its Potential for America," Wisconsin State University, River Falls, Wisconsin. Advisors: Gary Rohde and R. Vern Elefson.

Second: JAMES N. TRAPP, "Is Public Law 480 Providing Hope for the Future?" Kansas State University. Advisor: John Sjo.

Third: DONALD C. COOPER, "A Prescription for Plenty," South Dakota State University. Advisor: Mark Powers.

Fourth: JAMES C. BARTLETT, "A New Concept for a Master's Degree in Agricultural Economics," University of Florida. Advisor: John Reynolds.

Fifth: RICHARD R. WAX, "Meat or Protein," University of Illinois. Advisors: Don Smith and E. E. Broadbent.

Debate contest

1969 debate question: "Resolved: That Federal legislation should be enacted to retard non-farm corporate firms from either the operation or ownership of farms."

First: South Dakota State University, RANDY WRIGHT AND KEN MYERS. Coach: Mark Powers.

Second: Southern Illinois University, Marlin Larson and Archie Duckworth. Coach: Donald Osburn.

Honorable Mention: Washington State University, John Coop and Norman Wills. Coach: Marleen Miller.

Honorable Mention: Michigan State University, Bob Milligan and Scott Christman. Coach: David Armstrong.

Financial Report

	1965–66	1966–67	1967–68	1969[a]	1970[b]
Cash awards	$600.00	$600.00	$ 600.00	$600.00	$ 600.00
Honorariums (Judges)	140.00	140.00	200.00	200.00	200.00
Newsletters and pictures	75.00	—	57.50	—	100.00
Plaques, keys, engraving	70.00	93.44	69.79	107.08	60.00
Printing and miscellaneous	—	—	90.24	24.27	50.00
	$885.00	$833.44	$1,017.53	$931.35	$1,010.00

[a] Estimated.
[b] Proposed.

It has been a real honor for me to have served as chairman of this committee these past three years. Members of this committee have worked very hard to make the Student Section program a viable and integrated part of this annual meeting and to impart to students the professional nature of this Association. I personally want to thank all members of the committee, the coaches, faculty, and other members of this Association who really make this program effective by their personal contribution of time and effort. Without their support and the support of the Executive Committee, this program could not have achieved its present level of participation and success.

Respectfully submitted,
Ken B. Boggs, *Chairman*

REPORT OF THE POSTWAR REVIEW COMMITTEE

As a part of its continuing obligation to serve the profession, the American Agricultural Economics Association has committed itself to have prepared a series of review articles. Members of the Association and graduate students have long expressed a felt need for a more efficient means to bring and keep themselves up to date in the literature of the different fields of agricultural economics. Another stimulus has been the successful series of review articles supervised by the American Economic Association and the Royal Economic Society, and published in the *American Economic Review, Economic Journal,* and *Econometrica,* also as four volumes in hard covers. Serious efforts will be made to use the best of these review articles as models.

Another goal of the enterprise is to assist agricultural economists and graduate students in their search for professional identity. This will be done by summarizing the contributions agricultural economists have made to knowledge in the different fields.

In general, the review articles will for each problem area or subdiscipline, assist us in our efforts to bring ourselves up to date by outlining the nature of the field, including the underlying theory as well as analytical developments.

Past contributions to the field will be indicated. Serious efforts will be made in each review article to dramatize future challenges.

The attached outline is tentative and subject to change as detailed outlines are prepared for specific review articles. For the present, it is planned to review literature from extension economists along with the rest of the agricultural economics literature. In certain problem areas where extension has had a large role to play (farm management, marketing, and commercial farm policy, for example), extension's contributions may be treated in a separate section, according to the judgments of the collaborators on that chapter.

At this stage, the Literature Review Committee plans to proceed by asking qualified members of the profession to prepare brief outlines that would indicate how a different problem area or subdiscipline might be reviewed. The economist may report with what he believes would be the uniquely best organizing principle, or he may bring back to the Committee more than one alternative approach. No irrevocable commitment has been made to the outline that follows. In Agricultural Marketing, for example, Professor Helmberger may report with two strategies: an outline of one review article that would deal with the broad field of Agricultural Marketing and Consumption, and another set of outlines that would deal with each subfield (two or more) in greater depth.

A certain amount of duplication is unavoidable. In fact, it can be argued that only by some duplication can the interdependence among the different fields be shown adequately.

It should be made clear that a request to an economist for an initial outline carries no implication that the individual asked to prepare the initial outline will later be commissioned to prepare the review article. Initial outlines will be reviewed by the Review Committee and in some cases revised before the outlines become an element in the negotiations between the committee and prospective authors. Outlines approved by the Commmittee will not be binding on prospective authors, but they are likely to serve as a starting point for the negotiations with prospective authors.

The committee hopes to have a subcommittee for each chapter. The subcommittee might include the authors of the review article, qualified reviewers of the article, and a member of the Review Committee. The subcommittee would provide to the authors whatever guidance and assistance that are indicated. The representative of the Review Committee would provide the linkage between each subcommittee and the Review Committee, which would bear ultimate responsibility for overall coordination.

LEE R. MARTIN, *Chairman*

REPORT OF COMMITTEE ON LITERATURE RETRIEVAL

At the 1968 summer meeting of the American Agricultural Economics Association, the Committee on Retrieval of Agricultural Economics Literature recommended to the Association that it establish an American Agricultural Economics Documentation Center in conjunction with the National Agricultural Library and publish a bimonthly *American Bibliography of Agricultural Economics (ABAE)*.

The Board of Directors accepted the report and at the winter meeting decided to establish the Center. In July of 1969 the American Agricultural Economics Documentation Center was established. The National Agricultural Library (NAL), the Economic Research Service (ERS) and the Statistical Reporting Service (SRS) will assume full responsibility for financing the Center, but the Center will function to meet the needs of agricultural economists as specified by the Association.

This report describes in more detail the developments leading to the establishment of the Center, the need for and characteristics of the Documentation Center, and some descriptien of a broader literature retrieval system.

Historical Development

The Association's first official recognition of the literature retrieval problem was at the 1960 winter meeting. At that time the Association agreed to co-sponsor in conjunction with the Social Science Research Council, at SSRC's expense, a conference to discuss the literature retrieval problem.

Dr. Harry Trelogan organized the conference for the spring of 1961. It was attended by 11 librarians and 8 agricultural economists. They concluded that there was a problem and that it could be solved. They recommended, as a first step, that the Association appoint a committee to design and obtain funds for a study of the bibliography control of agricultural economics literature and the bibliographic needs of agricultural economists. It was emphasized at the meeting that the final product might be the creation of a special tool, the Bibliography of Agricultural Economics. It was also stressed that this project would strengthen the entire profession by the process of upgrading its tools.

President Nicholls appointed the "Committee on Retrieval of Agricultural Economics Literature" immediately after he received the conference report, June 1961. He obtained approval from the Executive Council by mail. He appointed Harry Trelogan (chairman), Bennett White, and H. G. Halcrow to the committee. Dr. Trelogan worked with the National Agricultural Library and prepared a project that was submitted to the National Science Foundaton for support. The project was formally submitted for consideration in July 1962. The NSF, after two years of consideration, rejected the project.

The Association, in cooperation with the Economic Research Service and the Statistical Reporting Service, financed I. T. Littleton, a graduate student in Library Science at the University of Illinois and director of the D. H. Hill Library, North Carolina State University, to do an abbreviated study. The study was begun in 1964 and completed in 1968.

I. T. Littleton presented some of his findings to the Association at the 1967 fall meetings, and his paper was published in the proceedings issue. A bulletin, *The Literature of Agricultural Economics: Its Bibliographic Organization and Use*, North Carolina State University Technical Bulletin No. 191, reporting the complete results of the study, was published in March, 1969. The statistics and ideas presented by Littleton had a major influence on events to follow. They will be considered in greater detail later.

At the 1967 fall meetings, the Association decided to enlarge the size of the committee. The aim was to provide adequate representation for the various interest groups in agricultural economics in the form of a strong, well-balanced committee, which could represent AFEA and the profession in matters relating to all aspects of the literature of agricultural economics.

The Association provided the new committee with up to $4,000 to finance a joint workshop with the National Agricultural Library to consider subject categories, the NAL vocabulary, and other aspects of library services, especially assembling, storing, and announcing the literature of the profession.

The new committee, under the chairmanship of Fred Abel, held a workshop in January 1968. Attending were the committee members, 10 people from the National Agricultural Library and guests Harry C. Trelogan and Hal King of the Inter-University Communication Council. The product of that workshop and a few followup committee meetings was the committee report represented to the Association at the fall meeting, 1968.

The Literature Retrieval Problem

Every agricultural economist knows there is a literature retrieval problem. It has been expressed many times and in many ways. Dr. Trelogan, in the background material prepared for the 1961 conference, stated it this way:

> Within the field of agricultural economics . . . it is becoming increasingly difficult for researchers, teachers, and librarians to keep up with the ever-increasing torrent of publications. This problem is particularly acute with respect to "soft cover" non-periodical materials such as bulletins, circulars, and special reports . . .
>
> The agricultural economics researcher, at many schools, is frustrated in drawing upon published results; it is becoming increasingly difficult for agricultural economics to be a cumulative body of knowledge in the research sense.

One aspect of the literature retrieval problem is that of bibliographic services, which include: (1) comprehensive and timely listings of documents in bibliographies, (2) proper cataloging (classifying) of documents, (3) proper indexing of documents, (4) systematically locating documents on library shelves, (5) quickly retrieving the documents from the libraries or obtaining copies by some other means, (6) publishing abstracts or extracts of documents, and (7) publishing summaries or state-of-the arts of research and selected areas (based on several documents).

Bibliographic Services Questionnaire

Dr. Littleton studied bibliographic services for agricultural economics literature. A questionnaire was sent to 590 agricultural economists; 379 or 64 percent were returned; many extension economists did not return the questionnaire.

Thoroughness and promptness

Respondents were asked to evaluate the *thoroughness* (comprehensiveness) with which existing bibliographic services report all important studies and the *promptness* with which completed research results are made known. Thoroughness of coverage was rated as excellent by 3.2 percent, as excellent or good by 65.4 percent, and as poor by 6.2 percent. Promptness was rated as excellent by 1.6 percent, as excellent or good by 28.7 percent, and as poor by 29 percent.

Indexing and abstracting

The respondents were also asked if the publications by the Economic Research Service were adequately indexed and reported in bibliographies. Of the 292 respondents who answered the question, 25 percent said they did not know; 37 percent and 38 percent said they were or were not, respectively, adequately indexed.

Discussion questions were asked to give the respondents a chance to suggest improvements in bibliographical organization. About 38 percent answered these questions. To the question, "Are there certain categories of publications which you have found inadequately indexed or abstracted?" agricultural experiment station bulletins were listed as being inadequately indexed by more respondents than any other type of publication. Another type of publication mentioned frequently as being difficult to find was workshop and conference proceedings, including mimeographed "working papers" and reviews of problems and research presented at industry conferences.

The questionnaire also included the question, "Do you have any suggestions as to how subject headings now being used in indexes and abstracting services might be improved?" In general, criticisms of present subject headings (descriptors, or keywords) fall into two categories:

1. There is need for greater depth of indexing, which means: (a) the use of a greater number of subject headings per item, and (b) that subject headings need to be more specific.
2. Subject headings need to be up-dated. Several respondents suggested that a thesaurus that could be constantly revised is needed because of rapidly changing terminology and the introduction of new areas of study.

Need for abstracts

Respondents were given seven forms in which research material might be presented and were asked to rank them on the basis of their usefulness. A first choice received 7 points; second choice, 6 points; and so on. The results are presented below.

Form	Score	Number of first choices
Short abstracts	1,754	123
Informational summaries of related studies	1,496	84
Complete texts	1,281	86
Critical summaries of related studies	1,251	51
Annotated Bibliography	1,069	54
Long abstracts	928	27
Un-annotated bibliography	434	7

There was general agreement that all types have their place, depending upon the purpose of the search.

Improvement of bibliographic services

The discussion question, "Do you have any suggestions for the improvement of the bibliographical control of the literature of agricultural economics?" was asked. A large number suggested some form of centralization of bibliographical reporting. About a dozen proposed the establishment of a center or central clearinghouse where important publications could be summarized and made available to a broad group of researchers and extension specialists. Some respondents suggested the need for critical review of groups of experiment station bulletins and USDA research bulletins. Several mentioned the time lag between publication and bibliographical reporting and requested greater speed in indexing and abstracting. A great many indicated that the computer should be used as an aid in speeding up and increasing the depth and comprehensiveness of indexing.

Above are the opinions of some of the members of our profession about bibliographic services. Dr. Littleton also made an objective study of bibliographic services.

Existing Bibliographic Services

Dr. Littleton's study was limited to the publications of agricultural economists in the United States, 1961 through 1963. Publications were obtained from the following sources:

1. A letter requesting a complete list of publications of staff members for 1961, 1962, and 1963 was sent to all departments of agricultural economics and some economics departments. All but two responded.
2. USDA publications were obtained from the "Checklist of Reports" issued by ERS and SRS. These lists include most of USDA agricultural economics publications. Included were all articles in *Agricultural Economics Research.*
3. Letters were sent to SRS in all state departments of agriculture requesting copies of their publications dated 1961, 1962, and 1963.

These various sources yielded 7,624 usable publications; 2,351 in 1961, 2,547 in 1962, 2,458 in 1963, and 267 with no date indicated. Of these, 51 percent were classified as research and professional, 44 percent as informational or popular, and 5 percent as miscellaneous.

Findings

Agricultural economists published 577 articles in 119 research periodicals and 1,815 articles in 347 information or trade periodicals. Agricultural economists publish in many, many different outlets. About 48 percent of publications are monographs (i.e., published as singles).

A sample of 1,527 publications was selected for checking with 8 bibliographical services to determine to what extent they were included by these services. Approximately 45 percent of publications by U.S. agricultural economists are indexed or abstracted by one or more of the eight services covered! Publications not suitable or appropriate for inclusion in any information system might be included in the original sample. However, 55 percent not indexed is very high. The indexing rates for various classes of publications are:

Class of publications	Percent indexed once or more
Total	44.54
Articles appearing in research and professional journals	80.5
Research monographs in a series	72.1
Articles in trade or informational periodicals	38.1
Informational reports or circulars	32.2
Unnumbered talks and papers	16.8
Unnumbered research reports	12.7

The indexing rates for publications from various sources are:

Source	Percent indexed once or more
U. S. government	65.3
National or regional organizations	54.1
Universities and colleges	45.9
Trade publishers and university presses	34.5

In short, indexing services miss 20 percent of the articles published in research and professional journals and 28 percent of research monographs in series (ERS reports, experiment station bulletins, etc.).

World Agricultural Economics and Rural Sociology Abstracts (WAERSA), the only bibliographical service specializing in agricultural economics, listed 8.7 percent of the publications. However, there has been substantial improvement since Littleton's study.

The *Bibliography of Agriculture* (*B of A*) *was the best service, including* 39.4 percent of the publications.

These data indicate the nature and extent of the problem of bibliographic services for agricultural economists.

An Answer

Dr. Littleton concludes, "In reviewing the special problems of selection, acquisition, and dissemination in agricultural economics, it seems clear that a specialized information center, working in cooperation with the National Agricultural Library, would be highly desirable to achieve control of the literature."

Thus the Association moved, early in 1969, to establish the Center. As originally planned, the Center would be run cooperatively by AAEA, NAL, ERS, and SRS.

As efforts were made to establish the Center, it became clear that it would be easier to administer if some of the functions were separated. Accordingly, the Center is funded by NAL, ERS, and SRS. Determination of what the Center will do and publication was left to the Association. Henceforth, the term "Center" will refer to the Center as it is being established by NAL-ERS-SRS.

The Center

The Center will be staffed with two full-time agricultural economists. The economists will be looking to the Association and users of the Center for guidelines on what to include in *ABAE* and how to index the items.

The objectives of the Center are:

(a) to acquire agricultural economics literature written by U.S and Canadian agricultural economists and other important related literature;

(b) to prepare the bibliographic data, copy abstract (if contained in original document), and index (assign keywords) for acquired documents;

(c) to have the prepared information transfered to computer tape;

(d) to make computer tape available to AAEA and other interested parties every two months;

(e) to maintain a master type with accumulated data from the bi-monthly tapes; and

(f) to perform computer searches on request and at cost.

The Center will have to establish its own system for acquiring and screening documents. The NAL will acquire the periodicals the Center needs. However, the Center does not want to review or scan periodicals that carry only one relevant article in three years (200 such publications revealed in Littleton's study).

If the Center is to obtain copies of articles published in remote journals or periodicals or papers presented at workshop or symposium, the author will have to send a copy of his publication to the Center. The Center can accomplish comprehensive coverage of the agricultural economics literature only if each agricultural economist assumes responsibility for sending copies or knowing that copies of his publications have been sent to the Center.

The Center will conduct computer searches of the master tape on request for cost. The cost will vary according to number of keywords used in the search and the number of documents on the tape. Cost for searches in the Pesticide Information Center have run between $35 and $180. The Center will not be in a position to make computer searches for a year or so. It is unlikely that a search of the collecton would be worthwhile before then anyway, since so few documents will be on the tape.

The Association is working to complete an agreement with NAL-ERS-SRS. The agreement will establish the formal relationship that will exist between AAEA and the Center.

There is no reason to go into detailed costs of the Center at this time, since AAEA will not be paying any of them. The annual cost of the Center will be about $50,000.00.

The Association's Role

Because the Center is going to be run, at least financially, independent of the Association, the Association's primary role is in publishing the bibliography. When completely operational, the Center will supply the Association with computer tape every two months containing the bibliographic data, abstracts, and keywords. It will be the Association's job to have the information on the tape transfered to a photo copy and to publish the bibliography. The Association may also find it necessary to publish an annual index of all the things contained in the monthly bibliographies.

The cost of the Association should be in the neighborhood of $15,000 per year. Thus, the members of the Association will be getting the product of a $65,000 a year literature retrieval service for about $15,000.

The American Bibliography of Agricultural Economics is scheduled to be published every two months. It should contain between 600 and 700 items. An item here means all the bibliographic information from a single document plus an abstract if contained in the original document. Each issue will contain a subject index. In the subject index, each of the keywords used to index at least one document will be printed. Behind the keyword will be the item number corresponding to the document to which that keyword was assigned. There will also be an author index and a corporate author index.

The Association agreed at the Chicago meeting last December that the first few issues of the bibliography would be sent to all members of the Association. After that, they would be given a chance to subscribe. The subscription to the bibliography would be independent of the subscription of the JOURNAL. I feel very strongly that to do it this way would be a mistake. All members of the Association will benefit from the services of the literature retrieval center. I see no reason why a few voluntary subscribers should subsidize the other members of the profession. There is evidence that voluntary subscriptions to a bibliographic service will not support the service; for example, the *World Agricultural Economics and Rural Sociological Abstracts* had a very low subscription rate with the idea that a large number of people would subscribe and pay for the system. However, voluntary subscriptions were very low. In order to solve the problem they raised their subscriptions rates to where it is now almost impossible for an individual to subscribe. Another example a little closer to home is the experience of the American Economic Association. When they started producing the *Journal of Economic Abstracts*, subscription to the abstract journal was voluntary. The option of subscribing was included on the membership dues form. Not enough members voluntarily subscribed, however, to cover the costs of the system. Their solution was to raise the dues of the Association $3.00 to cover the cost of the *Journal of Economic Abstracts*. Now every member of the Association receives the abstract journal along with the *American Economic Review*. This is the way I think our bibliography ought to be handled. Special arrangements would of course have to be made for our Canadian members so that they would not subscribe twice.

It was also decided at the Chicago meeting that subscriptions to the bibliography from libraries would be charged at a substantially higher rate than the charge to members. The exact charge has not yet been determined.

Literature Services—The Big Picture

Agricultural economists have known for a long time that there is a literature retrieval problem. We can all think of many cases where important research was done and we did not discover it until much, much later. We are also aware of how difficult it is to go back and make a comprehensive search of what kind of research has been done on any particular topic. The Agricultural Economics Documentation Center and the *American Bibliography of Agricultural Economics* are the first and very large steps for solving this problem. However, by themselves they will not meet all of our literature retrieval needs. There would be many other parts to a really comprehensive literature retrieval system.

The problems of dissemination and retrieval of knowledge of and about publications can be divided into three more specific problems:

1. becoming aware of documents recently published (by some form of announcement publication or citation index);
2. finding out something about the document (by some form of abstract and/or form of subject classification); and
3. locating historical publications (i.e., some form of literature retrieval system).

These problem areas are not independent, and partial solution to all of them will be contained in a single comprehensive system.

The first problem, becoming aware of documents, will be solved to a substantial extent by the *American Bibliography of Agricultural Economics*. There is another system—the citation index system—by which agricultural economists can become aware of documents.

In searching for documents relevant to a selected subject, it is often most productive to start with a recent publication written in the subject area to see what documents are cited. The search can be continued by locating the cited documents to see what documents they cited, and so on. A citation index is designed to facilitate this kind of search. If the index presents documents cited as well as documents doing the citing, it is possible to search forward. If, for example, a person were interested in inter-regional competition and knew of Heady's bulletin, they could search to determine whether anyone had written a document that cited Heady's bulletin.

A citation index can be developed independent of all other bibliographies services except acquisition. It is simple to prepare because there is no need for classifying, indexing, or abstracting, etc. Input for the index is simply copying, with no professional involvement except supervision. The ease of use and efficiency is primarily a function of how good a job of citing the author does.

There are many ways of finding out something about the document. They include a verbal report from colleagues, subject classification, index terms, abstract, reviews, and scanning the document. The bibliography will convey information about the documents by index terms and an abstract, if the abstract was included in the original document. There are no plans to provide additional information about the document at this time. A more comprehensive literature system might very well provide additional information, particularly in the form of reviews.

There are two parts to the third problem of locating historical publications. One part is obtaining the title and author of the publication, and the second part deals with getting a copy of the publication. The current system composed of the Center and the bibliography will help in locating historical documents from the time the Center is established forward. One can locate the documents by using the bibliography or later, when a larger collection is on the tape, by computer searches. If the citation index described above were established, it would also be a means of locating documents. Documents prior to the establishment of the Center would have to be located in traditional ways.

The Center and the bibliography will not help at all with the second problem —obtaining the publication. Agricultural economists will obtain the titles from the bibliography or the computer search and then use the usual means of obtaining hard copies. It is not planned that the Center would ever disseminate original or hard copies of the document. However, a comprehensive system might very well distribute microfiche of the document.

Since a microfiche system might effect all three of the problems concerned with literature retrieval, I will describe it in more detail. The microfiche is a four-by-six-inch transparency which will hold a micro-copy of sixty to seventy pages. If the publication is less than sixty pages long, it will be on one microfiche; if more than sixty pages, it would be on two or more microfiche. Only one publication would appear on any one microfiche. An eye readable title and accession number are printed on the top of the microfiche.

If desired, the Center could have a microfiche master made of all documents received in the Center. This would cost about $4.00 per fiche. If members wanted a copy of a document they would only have to send an order to the Center. The Center could copy the master microfiche and send the copies to the requester. The cost of copying a microfiche would be about 20 cents, which should be charged to the requester.

The microfiche could then be read on a special machine, now costing a little over a $100.00. There are machines, somewhat more expensive, that can reproduce from the microfiche a hard copy of any page. The hard copies would be very much like xerox copies.

There are many advantages to a microfiche system. People could keep the microfiche copies as long as they wanted. There would be no need to return them to the Center or to a library as in the traditional lending procedure. Microfiche dissemination would be an excellent way to distribute widely documents now printed for only limited distribution. To maintain a file of microfiche is much more convenient than a bookcase.

In a slightly more advanced system, the Center could maintain a file of the subject matter interest of all the members of the profession. The file would record the keywords or descriptors describing the area of interest of the members. As documents came into the Center, they would be microfiched. If the descriptors assigned to the document matched the descriptors listed by any of the members, a microfiche copy would be sent to them. The member could scan the microfiche and throw it away or store it according to whether it met his needs or not. A selective dissemination system like this would be quite expensive.

Those are the highlights of what could be an expanded literature retrieval system. All of these concepts were discussed by the literature retrieval committee at their January 1968 meeting. However, the committee did not make any recommendations concerning these expanded services. It was believed that the important task was to get the Center established and to get the bibliography published and disseminated. Now that this is being accomplished, it may be appropriate for the committee to go back and review these other services and make recommendations to the profession.

FRED H. ABEL, *Chairman*

Address of the AAEDC

After January 1, 1970, agricultural economists should send copies of their documents to:

American Agricultural Economics Documentation Center
National Agricultural Library
Care of S.B.M.U.
U.S. Department of Agriculture
Washington, D.C. 20250

REPORT OF THE PROFESSIONAL ACTIVITIES COMMITTEE

The officers of the American Agricultural Economics Association established the Professional Activities Committee in 1968 to assist in the achievement of its main objective: to further the development of systematic knowledge of agricultural economics. The Association continues to pursue this objective by facilitating scientific research, instruction, publications, meetings, and other activities designed to advance and disseminate knowledge in agricultural economics.

In addition to recognizing the objective of the Association and its activities, the committee further recognizes that its members are not universally and equally served by existing activities. Identifiable subgroups have specialized subject matter and area interests. The changing nature of our society, indeed, our total environment, forces review and reassessment of activities. Advancements in knowledge in related social and agricultural sciences particularly affect the posture of agricultural economics.

With these facts as given, the committee pledges that new or expanded activites will be proposed only if they further facilitate the achievement of the objective of the Association and at the same time encourage greater unity, cohesiveness, and relevance for those who pursue agricultural economics as a profession. It is in this spirit that the following list of activities was selected to receive early and serious attention by the committee.

1. *National Academy of Science.* It is the recommendation of the professional Activities Committee that the Association adopt a position of interest in involvement with the Division of Behavioral Sciences. Perhaps the best strategy to implement this interest would be moves to obtain the appointment of an agricultural economist to the members-at-large category of the division. Once this action is accomplished, the AAEA could be presented for recognition by the division.

To implement this recommendation, the board of the Association should prepare a list of two or three people whom they would support for appointment as members-at-large.

2. *Promotion of exchange of staff members between university, government, and industry.* The committee recognized this as a desirable area for development.

a. Exchange between university and government—Dr. Upchurch of ERS and Dr. Breimyer, president of the Association, have initiated communication efforts in ERS and the Association. Dr. Ray Scott, FES, also has written Dr. Breimyer concerning exchange between universities and FES. The committee encourages continued efforts to communicate opportunities.

b. Ron Aines as chairman of the Industry Committee has explored with the committee and members of the Professional Activities Committee ideas and opportunities for exchange between universities, government, and industry. A report at this meeting will be made by the Industry Committee.

3. *Accreditation or certification.* The committee discussed the opportunities and problems involved in accreditation of the departments of agricultural economics and certification of individuals as agricultural economists.

The committee quickly reached the conclusion that in their judgment the Association should not undertake such activities.

4. *AAEA Visiting Lecturer Program.* The committee recommends the establishment of a visiting lecturer program. The program would be somewhat similar to the AEA visiting scientist program. It is proposed that the universities eligible for the visiting lecturers would be those offering an undergraduate or master's degree in agricultural economics but not a Ph.D. degree.

The initiation of such a program would make available to Negro land-grant colleges, a number of non-land-grant colleges, and a few land-grant colleges that do not offer a Ph.D. the opportunity to schedule a lecture by a distinguished agricultural economist. By paying the travel expenses only of agricultural economists and by careful scheduling, $2,000 or $3,000 per year should make available professional stimulation to many students and faculty of non-Ph.D. schools.

The committee recommends the appointment of an AAEA Visiting Lecturer Program Planning Committee to develop plans and to obtain new funds. It would be the responsibility of this committee to develop procedures for selection and scheduling of the visiting lecturers as well as raising funds.

5. *Career planning information for undergraduate recruitment.* In June 1969, a questionnaire was distributed to 54 heads of departments of agricultural economics in the United States. It concerned the need for preparing a brochure describing professional careers based on academic training in agricultural economics. A majority of the departments of agricultural economics in the United States expressed definite interest in some kind of brochure on professional careers based on academic training in agricultural economics. More than half wanted some kind of national effort to at least consider this possibility more thoroughly. A few opposed "wasting Association and professional time" on this kind of project. Some registered reservations on the returns to such an effort. A few were also very optimistic citing what they termed a successful effort by the discipline of animal science on this kind of venture.

On the basis of the comments received and the evidence obtained in the questionnaire, we recommend that the president of the Association appoint a small committee of members to work with a professional writer in preparing copy for a potential national brochure. The committee should then recommend whether the copy should be released as a national brochure or as materials to be used by individual colleges in producing their own brochures. The committee might well be charged with preparing basic copy in the next six months and distributing a first draft to all departments for comment and reaction. The Association would be asked to underwrite costs of such an initial effort. The new committee on the basis of its work and experience should then recommend what subsequent action should be taken.

6. *Future Activities.* The committee plans at future meetings to investigate the following areas:

a. Dissemination of information on stipends for graduate students.
b. Development of curriculum for extension and resident instruction.
c. Need for exchange of information concerning AID research and educational activities.
d. New publication outlets for teaching, research, and extension.
e. Association sponsored review and evaluation panels, voluntarily requested by departments.
f. Association sponsored research and policy commissions.

Respectfully submitted,
R. J. Hildreth, *Chairman*

REPORT OF THE CONTRIBUTED PAPERS COMMITTEE

Contributed papers were assigned a more significant role in this year's annual meeting. At least three innovations are worthy of mention: (1) the overall program was modified to incorporate a larger number of contributed papers than previously, (2) some contributed papers were assigned to invited papers sections where topics were such to make it desirable, and (3) special contributed papers were invited to respond to a base paper published by Dr. James Shaffer in the May issue of the Journal. It is useful to classify the papers into two categories: (1) regular contributed papers and (2) special contributed papers. The latter refers to those responding to the Shaffer paper.

Papers were grouped according to the following title headings:

Session title	Received	Selected
	Number	
Regular		
1. Tools of our Trade	8	3
2. Empirical: Price Analysis, Marketing	21	6
3. Production Economics and Farm Management	16	5
4. Rural Development and Demography	18	4
5. Tools: Teaching, Research and Curriculum	9	4
6. Tools and Empirical: Natural Resources, Foreign Trade, Foreign Economic Development	13	4
7. (For invited sessions)	3	2
8. (Rejected because of length)	3	-
Total regular papers	91	28
Special		
1. Responding to Shaffer paper	14	3
Total contributed papers	105	31

In total, 105 papers were received (of which 102 were accepted) and 31 were selected by the committee. That gave a selection ratio of 30 percent. Since there will be about 60 presentations at the annual meeting, it means about one-half of all presentations will be contributed papers. More contributed paper sessions were arranged this year by the Planning Committee. At the same time session topics were more limited in scope than formerly.

The effects of this year's innovations cannot be evaluated fully at this time. It will be essential to get responses from those attending the meeting to have a complete evaluation.

In general, we were pleased with the quality of papers received. In some instances quality was lacking. But in those cases the number received was such that quality selections were possible. Some problems existed in classifying papers into groups. One was due to a misleading abstract but others were due to an attempt to fit papers received into topic areas that had been at least in part predetermined.

The innovation of special contributed papers in response to the Shaffer paper would appear to be a desirable one. But for one committee to handle these as well as the regular ones was confusing. Apparently it was confusing to those reading announcements calling for contributed papers. Also, extra problems were created in the mechanics for handling them. Perhaps a separate mechanism should be established to handle any special contributed papers in the future. Otherwise, we would recommend that the contributed papers activity be continued much as it was handled this year. It was gratifying to have such a splendid response from those submitting papers. Also, it is commendable that the Executive Committee would modify the annual meeting program to include such a large number of contributed papers.

MILTON L. MANUEL, *General Chairman*

REPORT OF COMMITTEE ON EVALUATION OF AAEA EMPLOYMENT SERVICES

President Harold Breimyer of the AAEA appointed a committee composed of R. J. McConnen of Montana State University, James Nielson of Washington State University and Max Thorp of the USDA both to evaluate and to investigate possibilities for improving the employment services provided by the AAEA during its annual summer meeting.

Potential employers and potential employees who used the employment services in 1968 were mailed the appropriate attached questionnaires in order to obtain information which would help the committee accomplish its objectives. All agricultural economics departments in land-grant schools and one-fourth of the remaining potential employers who used the AAEA employment service in the summer of 1968 were sampled. Of the 75 potential employers sampled, 58 responded. One-fourth, or 55, of the potential employees who used the AAEA employment service in the summer of 1968 at Montana State University were sampled. Of these, 34 responded. The results presented below refer to respondents only and not to the total number of potential employers and employees.

Results of Potential Employer Survey

As a result of using the services of the Employment Committee, five employers hired or completed negotiations for hiring professional personnel during the meeting. These positions were for four assistant professors, one GS-9 and one

GS-11. In all of these successful agreements, the employee made use of the employment service. Communications between the prospective employee and employer prior to the meeting were reported in three cases.

Twenty employers hired or completed negotiations for hiring 25 professional people because they became aware of the applicants during the meeting. These positions filled were 19 assistant professorships, two research fellowships, two as agricultural economists, and one each as instructor and civil service GS-12. The employee used the employment service provided by the AAEA in 23 of the successful agreements. Two employees who were hired made no use of the service. Communications prior to the meeting between the prospective employee and employer were reported in nine instances. Ten of the employees using the employment service had no prior communications with their prospective employers.

Negotiations initiated as a result of contacts made with the assistance of the employment services activities are still being pursued in ten cases. Forty employers reported that they are no longer negotiating because of contacts made at the meeting. This could mean that the positions are filled or that there were never any contacts made at the meeting.

Thirty-seven employers gained some information about the general supply of agricultural economists. Specifically, 19 responded that they gained reliable knowledge about the salary level of agricultural economists, 18 gained knowledge about the quality and training of the applicants and 4 learned about the interests of the applicants. Twelve respondents gained no or only limited information about the market for agricultural economists.

Of the employers who were recruiting, 39 responded that they had hired professional people without the use of the services provided by the Employment Committee at Montana State University (some employers were recruiting for more than one position). Personal contacts were credited as the basis for filling 32 positions. Four employers used other professional employment services.

Fifty of the respondents thought that it would be helpful to them if the Association would provide "market" information—especially salary information—about agricultural economists. Forty-nine would be willing to provide the necessary basic information if the Association were to provide information on starting salaries for agricultural economists of the type published in the table attached to the employer questionnaire.

Twenty-two commented that they would like to see the AAEA continue the service with some minor changes. Ten would like to see some major changes in the structure of the employment service. Many employers would like a brief digest of potential employees some time in advance of the meetings so as to screen the applicants before the time of appointment. "The present situation allows 20 people to bore a man and not give him an easy way to say—your credentials are not appropriate." It was also suggested that because of the openness of the applications some people will not file because they do not want to run the risk of formally entering the job market.

One person found the card and board method for arranging meeting times and places between employer and employee a game of blind man's bluff. Some complained of the crowded conditions of the meeting rooms.

One respondent went so far as to suggest that the AAEA have a national office and full-time staff so it could render a clearing house service for both those interested in employment and those seeking employees.

Some felt that the hurried pace of the "Employment Merry-Go-Round" took something away from the AAEA meetings and suggested that the service be held following the meetings, but not in competition with the program.

In general, however, potential employers found the employment service useful, particularly as a means of obtaining information about salaries, training, and other general market information. The present procedure means that using the employment service requires considerable time.

Results of Potential Employee Survey

As a result of using the services of the Employment Committee, three of the potential employees accepted or completed negotiations for accepting a professional position. These positions were as an accounting executive of the New York Stock Exchange and two assistant professors. In two of these three successful agreements, the employer made use of the employment service. Communications prior to the AAEA meeting between the prospective employee and employer were reported in one case. Thirty-one of the respondents did not accept or complete negotiations for a professional position at the AAEA meeting in Bozeman, Montana.

Eight potential employees accepted or completed negotiations for accepting professional employment because they became aware of these positions during the meeting. All eight of these positions were as assistant professors. The employer used the employment services in six of these cases. Communications prior to the meeting between the prospective employee and employer was reported in one case.

Negotiations initiated as a result of contacts made with the assistance of the Employment Committee's activities are still being pursued in two cases. Thirty-one reported that they are no longer negotiating because of the contacts made at the meeting.

Sixteen gained some information about the general demand for agricultural economists, nine found out more about the salary level of agricultural economists, eight gained knowledge about positions available in the field, and two learned about the qualifications about the general market conditions for agricultural economists.

Of the respondents who had not accepted a position because of negotiations held at the meeting in Bozeman, Montana, or because of negotiations completed after the meeting but which were initiated by the Employment Service, 13 have accepted positions which did not require any of the services provided by the Employment Committee. Personal contacts were credited for getting a position in seven cases. Three credited former faculty members with initiating the contacts, and three used other professional employment services.

Twenty-two prospective employees thought that the service should be continued or expanded. Four would like to see some major changes to make the service more efficient. Some thought that the service is primarily aimed at Ph.D. level for faculty positions. While the USDA and the universities were well represented several indicated that they would like to see a greater participation by industry.

A better organization for getting better information about job openings and prospective employees on file earlier was suggested.

One respondent suggested a year-round service which would be on a subscription basis to be paid for by the prospective employee and employer. This would include a monthly bulletin, a separate one for employers and employees, listing individuals available for employment with a brief vita and a listing of available openings with a description of the employing institution.

One person would like to see the service discontinued completely since the top jobs generally do not come through the service anyway. He thought that anyone strong enough to complete a Ph.D. should have enough "get-up-and-go" to find his own job.

The comments made by potential employees, indicated specific ways in which they thought improvements could be made. Only a few suggested the service could be eliminated. Suggested improvements indicated the desire for more copying equipment, better messenger service, greater privacy for interview areas, etc. It was also suggested that more information on jobs be made available before the meeting. To implement these suggestions would require considerable additional expense.

Recommendations

Based on survey results, there seems to be no basis for recommending that the Association stop sponsoring employment services at their annual summer meetings. While not a great many people were hired and not a great many positions were filled, the employment service does provide a means by which both potential employees and potential employers gather considerable market information.

The operation of the service could be improved, but the specific improvements would require more detailed study than was possible by this committee. One common complaint was the large amount of interview time required to utilize the service as it is presently operated. Suggested changes included restricting the availability of employment services to a period of time either before or after the main meetings and publication of information on employees and positions prior to the meeting. However, there appears to be no single improvement that could be made without considerable cost either in dollars or additional space for the employment service.

Employers indicated that the kind of salary information supplied by the table attached to the employer questionnaire would be very useful, and they would supply the needed basic information. Therefore we recommend that the Association investigate the possibility of publishing information on both the level and dispersion of starting salaries on an annual basis.

R. J. MCCONNEN, *Chairman*

REPORT OF THE NATIONAL BUREAU OF ECONOMIC RESEARCH DIRECTOR

This comment on recent activities of the National Bureau of Economic Research can cover only a few of the highlights that may be of interest to agricultural economists. Those who wish more complete information are referred to the Forty-eighth Annual Report, June 1968, and the Forty-ninth Annual Report, October 1969. There has been considerable emphasis on review of research programs. Some organization changes have been made in the Bureau to provide more flexible and efficient framework for developing new research activities.

Research Emphasis

The Bureau program, built on basic quantitative research on economic problems that are relevant and are expected to be important to our society in the years ahead, is shifting toward social measurement and economics of growth.

The major sections of research listed in the staff progress reports for the spring, 1969, are: (1) economic growth; (2) national income, consumption, and capital formation; (3) urban economic studies; (4) human resources and social institutions; (5) regional studies; (6) business cycles; (7) financial institutions and processes; (8) studies in industrial organization; (9) international studies; (10) econometric methodology; (11) research information processing; and (12) conference programs, including the Conference on Research on Income and Wealth and the Universities-National Bureau Committee for Economic Research. It is hoped that a new third conference series can be developed as an "Interinstitutional Conference on the Application of the Computer to Econometric Research." This conference would be somewhat along the lines of the Conference on Income and Wealth, with roughly 50 to 100 people from various universities, government organizations, and others from non-profit organizations meeting periodically to exchange information and otherwise to keep one another apprised of developments in the computer field. The conference is intended to reduce overlapping and duplication in computer analysis programs of various institutions and to serve as a forum for discussion of new ideas and techniques. Agricultural economists, who have pioneered much of the work in this area, should be interested in this development.

The Bureau will give considerably more attention to problems of social measurement and to the processes of economic growth if suggestions of many people familiar with work of the Bureau are followed. The most frequent response to a question from the president of the NBER about what the Bureau should emphasize in the 1970's was, "The Bureau in the 1970's should do for social statistics what it did for economic statistics in the 1930's."[1] A second rather common reply was that the Bureau should devote more attention to the processes of economic growth. Some urged that the Bureau concentrate exclusively on such studies.

These suggestions, if followed, will not be contrary to the long tradition of the Bureau, but they will involve an important shift in emphasis. Studies of the processes and consequences of economic growth or development will require that more attention be given to intersector relationships in the economy, to questions concerning improvement of environment, and to important areas of inquiry going beyond traditional market concepts. One of the most important basic assumptions underlying priorities in the work of many economists, perhaps including many at the National Bureau, almost since its founding in 1920, has been the idea that, if we could eliminate serious business recessions and keep the aggregative rate of growth in the economy to some respectable level such as 3½ percent to 4 percent a year, most other economic and social problems would tend to solve themselves. Increasingly, this assumption is being called into question. It is quite clear that we have achieved a high rate of growth for many years now, and economic recessions have been relatively minor. Surely the research in which the Bureau has been involved has contributed importantly to these two results, but large and significant economic problems exist that apparently will not be solved simply by maintaining stability and a high rate of growth in national product. Currently problems that plague society most, which have both social and economic implications, are mainly offshoots, by-products, or external diseconomies of the market-oriented system.

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[1] See John R. Meyer, "National Bureau: Continuity, Change and Some Future Perspectives," in *Toward Improved Social and Economic Measurement*, Forty-eighth Annual Report of the National Bureau of Economic Research, Inc., New York, June 1968, pp. 1–10.

Urgent demands for social and economic research that have been suggested or identified have to do with the environmental conditions and include items such as inadequate housing for particular segments of the population, inadequate recreational facilities, congestion in transportation, developing slums, air and water pollution, uneven or unequal employment opportunities, and an undesirable lack of aesthetics in the modern environment. A significant problem is the inadequate working of the factor market, particularly as it applies to labor, resulting in inequities and social unrest. The implication is that a private research organization such as the National Bureau should place more emphasis on research having to do with social measurement, with problems of welfare or equity, and with research pointing the way to improvement in society's organization and environment. Research on business cycles and on questions of stability apparently has progressed—importantly as a result of National Bureau leadership—to the point where more urgent research priorities exist.

Analytical Approaches and Disciplines

A more comprehensive analytical approach will be required if the problems mentioned are to be researched adequately. The new approach bears a relationship to "systems analysis." It will require both micro- and macro-analytic models of growth. An appropriate research design will need to accommodate the interdependencies, non-linearities, and other complications in processes by which groups and institutions adjust to economic change. The essence of such research is developing a better sense of how different parts of the economy relate to one another.

The trend toward social measurement in Bureau research will involve some projects chosen at the interface between economics and other social sciences. The Bureau staff, which has been made up almost entirely of economists, may need to include other social scientists, such as sociologists and psychologists, who have much to teach economists about basic sources, survey techniques, field work, and strategies for improving data in the area of social measurement.

Although the major emphasis of the suggested research relates primarily to the urban economy and its complications, there also is much in this that should be of interest to agricultural economists. We are concerned first with a segment of society that has seen its welfare problems accentuated and some of them exported to the urban sector while, at the same time, the markets for most factors used in agriculture have improved in quality and efficiency. We are concerned not only with how resources are organized and allocated in agriculture and the rural community, but with how the adjustments between urban and rural community can proceed with more efficiency, greater equity, and more recognition of the dignity of people. The growth and adjustment process requires more help for people in fitting into the modern economy. We are or should be greatly concerned with reducing imperfections in the intersector resource market, particularly as it applies to people. Some of the most acute urban problems—congestion, decay, poverty, and racism—have an important part of their roots in the inadequacies of education and social services in the rural society, in the lack of job training offered to migrants from rural areas, and in the failure of the business community to maintain a satisfactory rate of growth and improvement in rural sectors. Such problems need further research, and the question of how agricultural economists can contribute or correlate important parts of their work with the National Bureau is of increasing importance to us.

In Summary

Efforts to move toward social measurement and economics of growth or toward using the tools of economic analysis to aid in achieving social objectives are regarded as a shift in emphasis rather than as a break with the tradition of the past 50 years. Much will go on as before; but some of the new orientation is already evident in the Bureau research on education and medical economics. The goal is to move into other problem areas where environmental improvement is most urgent. In this research, as well as in the more traditional areas, more emphasis is being placed on development and use of modern tools of econometrics, mathematical theory, and the electronic computer. Both in new and in more traditional areas the Bureau hopes to play a greater role in organizing research resources, in complementing programs of research in universities, government, business, and other foundations, and in stimulating new ideas and hypotheses for research. Agricultural economists will benefit by greater awareness of these trends, and the Bureau program may be strengthened by their greater involvement.

HAROLD G. HALCROW, *Director, National Bureau of Economic Research,* representing the American Agricultural Economics Association

MINUTES OF THE EXECUTIVE BOARD MEETING

Chicago, Illinois, December 27–28, 1968

Meeting called to order at 3:00 P.M., December 27, 1968.

Present:

Members: Breimyer, Hathaway, Dunbar, Hillman, Butz, Wharton

Ex officio: Kearl, Swanson, Rudd, Nielson

Guests: Ackerman, Jones, Redman, Hamilton, Hildreth, Upchurch

1. Dunbar moved approval of the minutes of the meeting of the Initial Governing Board and the Executive Board held at Bozeman, Montana, August 1968. Seconded. Passed.
2. Breimyer discussed the organizational committee structure and the assignments of Board members of the Association.
3. Hamilton reported on local arrangements for the Chicago winter meetings.
4. Jones reported for McConnen on the finances of the annual meetings held at Montana State University. The deficit, according to Jones, is $3,188.90. Written reports have been mailed but have not arrived. The subject of the deficit was discussed, and the matter was postponed pending receipt of the reports.
5. Redman presented a budget and reported on preparations for the annual meetings to be held in Kentucky in August 1969. Hillman moved that the Kentucky meetings budget be revised and $200 allocated for women's activities with $100 for coffee and $100 to be used as needed. Seconded. Passed. Hillman moved that up to $200 be provided for young people's entertainment on Tuesday evening. Seconded. Passed. Other changes to be made reduced the budget to $9,950. Dunbar moved that the registration fees be:

Regular members	$ 8.00	Individual
	11.00	Family
Graduate students	6.00	Individual
	9.00	Family
Non-members	12.00	Individual
	15.00	Family

Seconded. Passed.

Meeting recessed at 5:30 P.M.

Meeting reconvened at 7:30 P.M.

Present:

Members: Breimyer, Hathaway, Dunbar, Hillman, Butz, Wharton

Ex officio: Kearl, Swanson, Rudd, Nielson

Guests: Ackerman, Jones, Redman, Hamilton, Hildreth, Upchurch

6. Swanson reported that he is completing the work on the Proceedings issue of the *AJAE* and that the arrangements have been completed for Fuller to take over the editorship.
7. Ackerman reported that the joint ASA-AAEA Advisory Committee on Agricultural Statistics had not met but that it had formalized its organization with rotating membership made up of three members from each association and an elected chairman. The committee was requested to have as one of its charges the review of the adequacy of available statistical information and the consideration of studies that need to be made. Dunbar moved that the committee be encouraged to develop proposals for an evaluation and appraisal of agricultural statistics, that members be added to the committee as needed and that the payment of expenses as necessary for up to two meetings for the joint ASA-AAEA Committee be made by the Association. Seconded. Passed.
8. Ackerman raised the question of the Association's financing a meeting of the Fellows Election Committee. No action was taken.
9. Ackerman reported activities in advising on the U. S. Census.
10. Hildreth reported that the Professional Activities Committee had met and had considered the philosophy and policies to be guide lines for the work of the committee. The committee is to meet in March and will prepare proposals to bring to the Executive Board at its August meetings.
11. Kearl reported on the membership of the Association and indicated that it has not increased during the year as it should have done. Wharton pointed out the possibilities of lowering the cost of foreign subscriptions as a means of increasing the service of the Association to foreign agricultural economists living in areas where there are exchange problems.
12. Breimyer presented a proposal by the Student Affairs Committee to raise funds for the student association through the sale of membership certificates. It was pointed out that the student organization has no status as far as the present Constitution and Bylaws of the Association are concerned. Breimyer is to contact Neil Harl with regard to drafting rules for organization of the Student Agricultural Economics Association Clubs and their relation to the AAEA.

13. Breimyer discussed the Association's relation to CEANAR and the National Academy of Science. Upchurch is to obtain information about the Academy for distribution to the Board members. The Association's relationship with CEANAR and the National Academy is to be considered by the Professional Activities Committee.
14. Breimyer discussed the question which has been raised as to the effectiveness of the employment center at the annual meetings. Nielson, McConnen and Tharp are to be asked to serve as an ad hoc committee to study the matter.
15. The matter of the preparation of a brochure on career opportunities in agricultural economics was considered. No action was taken on the specific proposal. The matter of recruiting students will be considered as a part of the work of the Professional Activities Committee.
16. Breimyer indicated that he will attempt to improve communications with members of the Association via letters to the members and may initiate a special mailing for this purpose.
17. Wharton moved that Rhodes, Chairman of the Department of Agricultural Economics at the University of Missouri be authorized to contract with the appropriate officials at that university for housing and dining facilities in connection with the 1970 annual meetings. Seconded. Passed.
18. Breimyer expressed his opinion that businesses and others who wish to support the activities of the Association should be supporters of the Association through its Sustaining Membership program which has the particular function of financing the Awards Program. Wharton moved that the Board support the position of the President. Seconded. Passed.
19. Hathaway moved that the Board meet on the Saturday and Sunday prior to the Kentucky annual meetings. Seconded. Passed.
20. Breimyer reported the progress in developing the annual meetings program.

Meeting recessed at 10:30 P.M.

Meeting reconvened at 10:30 A.M., December 28, 1968.

Present:

Members: Breimyer, Bishop, Toussaint, Butz, Dunbar, Hillman, Hathaway, Southern

Ex officio: Rudd, Nielson, Kearl

Guests: Fuller, Redman, Martin, Upchurch, Hildreth

21. Further discussion of the budget for the Kentucky annual meetings involved an increase in the administrative allowance for secretarial help to $2,400 and adjustments in the reserve funds to balance the budget. Hathaway moved that the budgeted expenses and receipts for the Kentucky meetings be approved as amended and that the registration rate be set as previously approved. Seconded. Passed.
22. Martin reported the activities of the Committee on Postwar Work in Agricultural Economics. The committee proposes that a series of review articles be prepared and published over the next five years and that, although financing should be obtained elsewhere, the Association should underwrite the project to enable the committee to move ahead. Southern moved that the report be accepted, the committee be discharged, and a steering committee for the project be appointed. Seconded. Passed. Hillman moved the ap-

pointment of a steering committee, composed substantially of the same individuals as the review committee, to firm up the outline for the review series and prepare a budget. The committee is to be authorized to commission articles without honoraria. Expenses for committee meetings are authorized. Seconded. Passed.

Meeting recessed at 11:45 A.M.

Meeting reconvened at 12:50 P.M.

Present:

Members: Breimyer, Hathaway, Butz, Toussaint, Dunbar, Southern, Bishop, Hillman

Ex officio: Nielson, Rudd, Kearl

Guests: Fuller, Redman, Hildreth, Ackerman, Upchurch

23. Fuller reported the progress in taking over the editorship of the *AJAE*.
24. Nielson presented a report for the Awards Committee. It was suggested that a review be made of the awards program and the criteria for making selections of award winners. In lieu of a review the Awards Committee is encouraged to revise, as needed, the rating sheets and other methods of determining award winners.
25. Southern discussed the activities of the Committee on the Retrieval of Agricultural Economics Literature and explained the project for establishing a Documentation Center. Hillman moved that the Association approve the project and that a Directing Committee be appointed, including a Canadian member. The committee is to be authorized to move ahead with the development of the Documentation Center. It is to develop plans for a cooperative agreement with the National Agricultural Library and the Economic Research Service for the operation and financing of the Center including the solicitation of outside funds as may be needed. It is suggested that consideration be given to financing the Center through subscription rates for the service. These subscription rates would be varied, depending upon whether the subscriber was a library, department, or individual. The Association is to underwrite the cost of the service to the extent of a total of $50,000 over a period of three years. Initially, all members of the Association and subscribers to the *AJAE* are to receive listings from the Center with the announcement that such service would be given on a continuing basis for a subscription payment over and above the regular *AJAE* subscription. Seconded. Passed.
26. Southern moved that the Board should encourage the expansion of the Association's student activities to schools of all sizes and kinds, including Canadian and non-land-grant institutions. Seconded. Passed.
27. The financial problems in connection with the Montana meetings were briefly reconsidered and the President and Secretary-Treasurer were instructed to obtain more information as to the nature of the deficit.

Meeting adjourned at 2:15 P.M.

MINUTES OF THE EXECUTIVE BOARD MEETING

Lexington, Kentucky, August 16–17, 1969

The meeting was called to order by President Breimyer at 9:05 A.M. August 16, 1969.

Present:

Voting members: Breimyer, Hathaway, Dunbar, Butz, Toussaint, Wharton, Hillman, Bishop (Absent Southern).

Ex officio: Kearl, Purnell, Fuller, St. Clair, Rudd.

Guests: Mather, Brannon, West, Redman, Aines.

1. Kearl moved approval of the minutes of the Executive Board meeting held at Chicago, Illinois, December 27-28, 1968. Seconded. Passed.
2. Kearl reported for the Tellers Committee that Hillman was elected as the President-Elect and Hildreth and Tweeten are to be Board Members.
3. Brannon reported for the Publicity Committee.
4. Mather reported for the Employment Committee.
5. Redman reported for the Local Arrangements Committee. Among other things, he indicated that the meetings were getting bigger and more complex and presented major problems which must be considered.
6. Hathaway moved that the President write a letter to Miss Hanly expressing appreciation for her efforts and service in connection with the meetings. Seconded. Passed.
7. The matter of private companies or other groups requesting the Local Arrangements Committee to make arrangements for such things as meetings and luncheons at the time of or associated with the annual meetings was considered. Hathaway suggested that arrangements be permitted but that a fee be charged for the services. Breimyer indicated that a committee has been appointed to consider guide lines for the host institution in the conducting of the annual meetings and is to report to the Executive Board at its winter meeting.
8. Breimyer reported for the Audit Committee. Hathaway moved authorization for the expenditure of funds for a CPA audit in connection with the transfer of the office of Secretary-Treasurer at the close of 1969. Seconded. Passed.
9. Kearl presented the Secretary-Treasurer's report. Hathaway moved approval as presented. Seconded. Passed.
10. Kearl presented the Investment Committee report.
11. There was a discussion of the change-over of the office and the date of change of membership on the Board. One suggestion was that the new officers and Board take over at the first of the year and that the Constitution be so amended. Dunbar moved that, in accordance with the Constitution, it should be understood that the President and other elected officers of the Board should serve for the year beginning with the adjournment of the annual meeting and have responsibility for the affairs of the Association through the next annual meeting. Seconded.

    Bishop moved that the newly elected Board Members be invited to attend and participate in the meetings of the Executive Board. Seconded. Passed.
12. The Montana meeting deficit was discussed but action was deferred.

13. Dunbar moved that travel expenses for Redman and his secretary be approved in connection with the move of the office of Secretary-Treasurer. Seconded. Passed.
14. Breimyer reported on the membership and operation of the committees for the 1968-69 year and made recommendations for modification of the committee structure.

    Dunbar moved that a resolution should be presented to the membership to delete the standing committee for "Relations With Other Professional Organizations" and that the functions be transferred to other committees of the Association. Seconded. Passed.

    Hathaway moved that a new standing Committee on Economic Statistics be presented to the membership of the Association with the understanding that the present special joint ASA-AAEA Committee on Agricultural Statistics be a subcommittee of the standing committee. Seconded. Passed.

    Hathaway moved that the present special Committee on Professional Problems in International Research be renamed as the Committee for International Activities and that the chairman be a member of the standing Professional Activities Committee. Seconded. Passed.

    Hathaway moved that the Extension Affairs, Industry Affairs, and International Affairs be special committees of the Association, and that their chairmen, and the chairmen of such other committees as should be designated by the Executive Board, should be members of the standing Professional Activities Committee. Seconded. Passed.
15. Hathaway presented the tentative AAEA committee appointments as of this date.

The meeting recessed at 12:00 noon.

The meeting reconvened at 1:30 P.M.

Present:

Voting members: Breimyer, Hathaway, Butz, Toussaint, Wharton, Hillman, Bishop (Absent Southern).

Ex officio: Purnell, Kearl, Fuller, Godwin, St. Clair.

Guests: West, Aines, Abel, Day, Rudd, Redman, Stanton, Upchurch, True, Ackerman, Eley, Martin, Taylor, Boggs, Harl, Halcrow, Hildreth, Manuel.

16. Abel reported for the Literature Retrieval Committee. Plans are being made for the establishment of the American Agricultural Economics Documentation Center through the joint efforts of the NAL, ERS, SRS, and AAEA. NAL, SRS, and ERS are to be responsible for the financing and the work of the Documentation Center and will prepare a tape of the bibliographic information. This tape can be obtained by AAEA for publication. A memorandum of understanding is being drawn up by the groups indicating the responsibilities. It was suggested that AAEA should appoint a separate person to work with the governmental agencies, to help coordinate the efforts and to handle the publication of the bibliography. This bibliographical editor and a committee to work with him would obtain feedback from the membership and others and, by close contact with the persons operating the Documentation Center, help to make the materials collected and the method of publication more effective and more in line with needs.

Hillman moved the appointment of a Bibliographical Editor and a Council to supervise the publication. Seconded. Passed.

Hathaway moved that the Executive Board go on record in favor of signing a memorandum of agreement with the NAL, ERS, and SRS and AAEA including a commitment to publish. Seconded. Passed.

Purnell indicated that CAES was interested in cooperating in connection with the Documentation Center and the bibliographical publication.

17. Martin reported for the Postwar Review Committee. The committee has met and revised the original outline of review articles and has given consideration to individuals who might be requested to write parts of the review series.
18. Boggs reported the activities of the Student Affairs Committee.
19. Harl presented a proposal for a change in the Association Bylaws to provide for a Student Section of the AAEA.

    Hathaway moved that the suggestions made by Harl be adopted as Article 13 of the Bylaws and that present Article 13 be redesignated as Article 14. Seconded. Passed.
20. West reported the activities of the Membership Committee.
21. Kearl reported the activities of the Sustaining Membership Committee.
22. Hildreth reported the activities of the Professional Activities Committee.

    Bishop moved that recommendation number one of the report be adopted. That recommendation is: That the Association adopt a position of interest in involvement with the Division of Behavioral Sciences. Seconded. Passed.

    Bishop moved that a visiting lecturer program be approved as one of the activities of the committee and that an ad hoc committee be appointed to initiate the program. Where self-funding, the program is to be started immediately and the committee is to bring to the Board proposals involving expansion of the program. Seconded. Passed.

    Hathaway moved that the Association accept the recommendation of the committee, that the President of the Association appoint a small committee of members to work with a professional writer in preparing copy for a potential national brochure on career opportunities in agricultural economics, and that travel funds be approved for not more than two meetings of this committee. The brochure will describe professional careers based on academic training in agricultural economics. Seconded. Passed.
23. Aines reported for the Industry Committee. Among other things, he indicated that the listing in the next Handbook-Directory should be changed to more adequately accommodate the industrial sector of the Association.
24. Halcrow reported as the representative of the Association to the NBER. He indicated some of the changes in the direction of the research of the National Bureau of Economic Research. It was suggested that he present a discussion of the research activities in an article for the membership to be published in the *AJAE*, and that there be a conference with NBER personnel at the winter meetings to discuss research needs of agricultural economics which might be relayed to the NBER directors.
25. Manuel reported on the Contributed Papers Committee activities.

Hillman moved adjournment of the meeting at 5:30 P.M., August 16, 1969.

The meeting was called to order by President Breimyer at 9:00 A.M., August 17, 1969.

Present:

Voting members: Hathaway, Breimyer, Bishop, Hillman, Dunbar, Wharton, Toussaint, Butz (Absent Southern).

Ex officio: Kearl, Fuller, Godwin, St. Clair.

Guests: Hildreth, Tweeten, Redman, Aines, Abel, Ackerman, Castle, True, Eley, McKinsey, Ruttan, Day, McConnen.

26. McKinsey, general chairman of the 1970 annual meetings to be held at the University of Missouri, reported on local arrangements.
27. Breimyer reported on the plans and problems in connection with the arrangements and location of future annual meetings.
28. Breimyer announced the request of IAAE for $5,000 for travel grants to the international meetings. The matter was set aside until later.
29. Breimyer reported that the Richard Abel Company had requested permission to reproduce AAEA sponsored publications. Hathaway moved that the President be authorized to permit the reproduction of official publications of the Association, with any royalties therefrom accruing to the Association. Seconded. Passed.
30. Breimyer raised the question of exhibits at the annual meeting. The matter is to be considered by the ad hoc committee which is to study annual meetings problems and policies.
31. Breimyer announced that there had been questions raised as to the three-year limit for junior members. This has previously been discussed several times. No action was taken.
32. Ackerman announced that three men had been elected Fellows of the Association.
33. Ackerman reported the activities of the ASA-AAEA joint statistical committee. The committee has felt that it should serve in more than an advisory capacity and that it should have a program of its own. Efforts will be made to move in this direction.
34. Ackerman reported on his activities as the AAEA representative to the Census Advisory Committee.
35. Fuller reported the activities of the Editor. He indicated that, in accordance with past policy established in 1961, papers which have been presented at the WAEA meetings and are subsequently submitted for publication in the *American Journal of Agricultural Economics* will be considered on their merit as articles of the *AJAE* and will be subjected to the usual review. Gerald Dean will serve as a second associate editor of the *AJAE*. Fuller indicated that he had contacted the principal printers of journals to obtain quotations for printing the *AJAE* and feels that there is no evidence that the Association can save money by changing printers. Savings can be made by changing the style and size of the journal, the cover paper, and the size and style of the type. Redman reported that his contact in Lousiville indicated similar conclusions. Fuller proposed that we continue to have the George Banta Company, Inc., print the *American Journal of Agricultural Economics* but that we shift to a 7″ by 10″ double column size, change the cover, and change the type styles in order to have easier composition at the printers. He also proposed that we stay with the present type

of paper. He further proposed that the American Bibliography of Agricultural Economics be published in the same size publication. Bishop moved that the proposals be accepted. Seconded. Passed.

The changes are to occur with Volume 52, February 1970. The November and December issues of 1969 are to be the same size as the present journal but under the new contract as proposed by the George Banta Company, Inc.

There was discussion of coordinating the publication of articles printed in the *AJAE* and papers presented at the annual meetings. This would be an effort both to improve the *AJAE* and to reduce printing costs.

Wharton moved that arrangements be made for the Editor to be informed as to the main theme of the meetings, in order that he can obtain or refer papers to the President for use in the meetings. Further, that the Proceedings issue be retained but that the full text will be printed only for such articles as the Presidential Address, major papers as determined by the President and Editor, and reports and minutes. Other papers are not to be printed in total but are to be submitted and printed as abstracts. There is to be no barrier in later submitting these papers to the *American Journal of Agricultural Economics* for publication, in which case they would be subjected to the usual review procedure. The details and procedures are to be worked out and reported upon at the winter meetings. Seconded. Passed.

36. Kearl presented information regarding a proposal for publishing a Handbook-Directory. Hathaway moved that items 2-5 of the report of the Handbook-Directory Committee published in Volume 49, No, 5 of the JFE be implemented for the publication of a Handbook-Directory in 1971. Seconded. Passed.

    A committee is to be appointed to arrange for the publication of this issue.

37. Kearl presented the budgetary problems of the Association.

    Dunbar moved that a charge of $5.00 be made for each back issue ten years of age and under and $10.00 for each back issue over ten years of age. Seconded. Passed.

    Hathaway moved that the present reprint prices continue to remain for the November and December issues and that the matter be considered at the December meetings for future prices of reprints. Seconded. Passed.

    Hillman moved that the advertising prices be changed per the recommendation for the November and December issues and be revised at the December meeting to consider new publication and costs. Seconded. Passed.

The meeting recessed at 12:00 noon.

The meeting reconvened at 1:30 P.M.

Present:

Voting members: Breimyer, Hathaway, Butz, Hillman, Toussaint, Wharton, Dunbar (Absent Southern).

Ex officio: Kearl, Fuller, St. Clair, Godwin, Purnell.

Guests: Ruttan, Timm, Castle, Aines, Tweeten, Hildreth, True, Abel, Eley, McConnen, Ackerman, Sinclair, Trelogan, Schmedemann, Redman, Manning, Hawkins, Derr, Rudd, Halcrow, Wills, Tefertiller.

38. McConnen reported on the finances of the Montana meeting. Unusual expenses due to rain and other things resulted in unanticipated expenditures and caused meetings deficit.

    Dunbar moved that AAEA allow Montana State University to keep the $1,000 advanced by the Association and close the books. Seconded. Passed.

39. Ruttan reported for the International Activities Committee.

    Hathaway moved that the Association appropriate $5,000 for travel grants for young men of the Association and that a committee of the American Agricultural Economics Association and the U.S. Council of the International Agricultural Economics Association be appointed to name the persons to receive the travel grants. Seconded. Passed.
40. Toussaint moved that two copies of the *American Bibliography of Agricultural Economics* be distributed to all members and subscribers without charge and that an annual charge of $10.00 be made for institutions and $3.00 for individual subscribers. Seconded. Passed.
41. Hathaway moved that the American Agricultural Economics Association rates be changed to $25.00 for subscriptions to the *American Journal of Agricultural Economics*, $15.00 per year regular Association dues, and $5.00 per year junior member dues. Seconded. Passed.

    In accordance with the Constitution, the matter of the dues is to be presented to the membership for approval at the annual meeting.
42. Dunbar moved the approval of the 1969 budget as revised. Seconded. Passed.
43. Derr and Hathaway reported on the New York winter meetings arrangements.
44. Castle reported on the activities of the Awards Committee. Hillman moved acceptance of the report. Seconded. Passed.

    Toussaint moved that the rules of the contest be changed to allow the submission by a department of one Ph.D. thesis for each twelve Ph.D. candidates, and one M.S. thesis for each fifteen M.S. candidates. Seconded. Passed.

    Hathaway moved the recommendation number one, "That the number of extension awards be limited to one, unless there are more than ten entries," be approved. Seconded. Passed.
45. Future meeting places were discussed. Manning presented an invitation from the University of Alberta to hold the meetings at Edmonton, Alberta, in 1973. The meeting dates would be the second Wednesday in August. Wills presented an invitation from Southern Illinois University to hold the meetings at that institution in any year. Timm reported that Texas A&M University preferred to delay hosting the meetings until 1972 or 1974. Tefertiller indicated that it would be difficult or impossible for the University of Florida to change from 1972, in view of the present commitments.

    Hillman moved that the Association meet at Southern Illinois University in 1971, the University of Florida in 1972, the University of Alberta in 1973 and Texas A&M University in 1974. Seconded. Passed.
46. McConnen reported for the ad hoc committee on the evaluation of the American Agricultural Economics Association employment service. He stated that there was no reason to discontinue the service, that it seemed to

be rendering acceptable service even though improvements could be made. Hathaway moved acceptance of the report. Seconded. Passed.

Redman reported that Loys Mather has been particularly interested in the employment activities and should be asked to report at the winter meetings on the possibility of the Association operating an employment service year-round.

47. Breimyer reported on the SIPPS proposal, and Hathaway moved that an individual be appointed to represent the Association in contacts with Mr. Ruggles in the matter of the SIPPS proposal and report to the Board.
48. Hillman moved to accept the report of the AAEA representative to the National Research Council and to continue having a representative to the Council. Seconded. Passed.
49. Dunbar moved that the Nominating Committee as named be approved with the addition of the USDA representative. Changes will be made as needed where persons have not been able to be contacted prior to meetings. Seconded. Passed.
50. The investment policy was discussed and the President was encouraged to make such changes in the Investment Committee as he feels are necessary to provide for continuity and yet constant reevaluation of the Association's position.
51. Dunbar moved the appointment of Redman as Secretary-Treasurer and Fuller as Editor of the *AJAE* as of January 1, 1970.
52. The question of joining other societies in hiring a lobbyist to work in Washington, D.C., was raised. No action was taken.
53. Hillman moved that, provided AAEA were invited to appoint a representative, Bishop be appointed as the AAEA representative to the Behavioral Science Commission if he will so serve. If Bishop declines to serve, the President is authorized to make some other arrangement.
54. Sinclair presented a request of the New England Agricultural Economics Council for joint membership with the AAEA and ex officio membership on the AAEA Board.

    Hathaway moved that the New England Agricultural Economics Council be accepted as a joint member and that the president of that Association be an ex officio member of the AAEA Board. Seconded. Passed.
55. The question of the procedures of the AAEA elections was raised and the possibility of some other methods was considered. Breimyer is to present a statement on the matter at the winter meeting of the Board.
56. Wharton is to present to the Board at the winter meeting a paper considering the matter of the Association taking stands on such things as legislation and the possibility of action which would enable the Association to be influential in bringing about changes which might seem desirable.

The meeting adjourned at 5:35 P.M.

MINUTES OF THE ANNUAL BUSINESS MEETING

Lexington, Kentucky, August 19, 1969

Meeting called to order by President Breimyer at 10:35 A.M.

1. President Breimyer presented for approval the minutes of the annual business meeting held at Bozeman, Montana, August 20, 1968, as pub-

lished in the Proceedings issue of the *AJAE*. Upchurch moved approval. Seconded. Passed.

2. Breimyer presented the annual report of the President.
3. Kearl presented the Investment Committee report for the fiscal year January 1 through December 31, 1968.
4. Kearl presented the Secretary-Treasurer's report for the fiscal year January 1 through December 31, 1968.
5. Breimyer presented the report of the Audit Committee.
6. Hildreth presented the resolution thanking Kearl for service to the Association as Secretary-Treasurer. Seconded. Passed.
7. Breimyer reported the actions of the Executive Board. These include: (a) formalizing the undergraduate student organization activities by adopting AAEA enabling bylaws; (b) approval of the Professional Activities Committee proposal for a visiting lecturer program and the publication of a career opportunities brochure; (c) approval of a change in the size and style of the *American Journal of Agricultural Economics* and a change in the Proceedings issue to print major papers in total and other papers in abstract form; (d) a change in the policy of accepting contributed papers which would enable these to be integrated more completely into the annual meetings program; (e) approval of plans to go ahead with the publication of a Handbook-Directory in 1971; (f) approval of a grant of $5,000 for travel grants for young agricultural economists to attend the international meetings in Russia; (g) approval for the publication early in 1970 of the *American Bibliography of Agricultural Economics* with the first two issues to be sent to all members and subscribers and an annual subscription rate of $10.00 for libraries and institutions and $3.00 for members; (h) a change in the awards program so that there would be two extension awards only if there were ten or more entries, otherwise there would be only one award given; also, departments are to be permitted to submit one Ph.D. thesis for each twelve Ph.D. students and one M.S. thesis for each fifteen M.S. candidates; (i) a decision to continue to have the employment service; (j) approval of the appointment of Varden Fuller as the Editor and John Redman as the Secretary-Treasurer effective January 1, 1970; (k) a decision to hold the annual meetings at the University of Missouri in 1970, at Southern Illinois University in 1971, at the University of Florida in 1972, at the University of Alberta in 1973 and at Texas A&M University in 1974; (l) approval of the New England Agricultural Economics Council as a joint member with the American Agricultural Economics Association, along with the Western Agricultural Economics Association, the Canadian Agricultural Economics Society, and the Southern Agricultural Economics Association.
8. Dunbar moved the following changes be made in the standing committees structure: delete the "Committee on Relations With Other Professional Organizations" and add a "Committee on Economic Statistics." Seconded. Passed.
9. Fuller reported the activities of the Editor. He announced that the JOURNAL would be changed in size to a 7″ by 10″ with two columns. There would also be a change in the type and the size of the type. He announced the appointment of Gerald Dean as an Associate Editor.
10. Hathaway discussed plans for integrating the *American Journal of Agricultural Economics* articles and the annual meeting program. He indicated

that the Presidential Address, the major papers, minutes and reports, and abstracts of other papers would be printed in the Proceedings issue.

11. Kearl presented a budget for 1970 for consideration by the membership.
12. Hathaway moved, with recommendation of the Executive Board, that the subscription rate for the *American Journal of Agricultural Economics* be set at $25.00, regular membership dues at $15.00, and junior membership dues at $5.00. Seconded. Passed.
13. Kohls raised a question as to the endowment fund policy.
14. Hillman presented a resolution thanking the University of Kentucky for hosting the meetings. Seconded. Passed.
15. Hathaway announced that (a) the December meetings will be held in New York City, December 27-30, 1969; (b) the chairman of the Nominating Committee is Harold Breimyer; (c) the Executive Board will appreciate receiving nominations for Fellows; and (d) the next meeting of the Association will be at the University of Missouri and will be held one week earlier than normal.

The meeting adjourned at 12:00 noon.

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION
(Act. of October 23, 1962; Section 4369, Title 39, United States Code)

1. Date of filing: September 29, 1969
2. Title of publication: American Journal of Agricultural Economics
3. Frequency of issue: Quarterly and December Proceedings Issue (February, May, August, November, December)
4. Location of known office of publication: Warren Hall, Cornell University, Ithaca, New York 14850
5. Location of headquarters or general business office: Warren Hall, Cornell University, Ithaca, New York 14850
6. Name and addresses of publisher, editor: American Agricultural Economics Association, Warren Hall, Cornell University, Ithaca, New York 14850. Editor: Varden Fuller, Dept. of Agricultural Economics, University of California, Berkeley, Calif. 94720
7. Owner: American Agricultural Economics Association, Warren Hall, Cornell University, Ithaca, New York 14850
8. Bondholders, mortgagees, and other security holders: none
9. Nonprofit organization: Status unchanged during preceding 12 months
10. The following circulation figures are provided for (a) the average number of copies of each issue during the preceding 12 months and (b) the single issue nearest to filing date:

Total number of copies printed	(a) 6,550	(b) 6,550
Circulation:		
Sales through dealers, carriers, etc.	(a) none	(b) none
Mail subscriptions	(a) 5,897	(b) 5,897
Total paid circulation	(a) 5,897	(b) 5,897
Free distribution	(a) 3	(b) 3
Total distribution	(a) 5,900	(b) 5,900
Office use, left-over, inventory balance, etc.	(a) 650	(b) 650
Total	(a) 6,550	(b) 6,550

I certify that the statements made above are correct and complete.

(Signed) C. D. Kearl
Secretary-Treasurer

COMMITTEES OF THE AAEA, 1968–69

Executive Board

Officers:

Harold F. Breimyer, President
Dale E. Hathaway, President-Elect
C. E. Bishop, Past President

Directors:

Dale E. Butz
John O. Dunbar
Jimmye S. Hillman
John S. Southern
William D. Toussaint
Clifton R. Wharton, Jr.

Ex officio:

C. Del Mar Kearl, Secretary-Treasurer
Varden Fuller, Editor
James Nielson, President, Western Agricultural Economics Association
Glen R. Purnell, President, Canadian Agricultural Economics Society
Robert W. Rudd/Marshall R. Godwin, President, Southern Agricultural Economics Association

AMERICAN JOURNAL OF AGRICULTURAL ECONOMICS

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Harold O. Carter, Associate Editor
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ex officio
John O. Dunbar,
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M. Louis Upchurch

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James T. Bonnen (AAEA)
Robert J. Eggert (AAEA)
A. L Finkner (ASA)
H. O. Hartley (ASA)
Raymond J. Jessen (ASA)

Contributed Papers Committee

Milton Manuel, Chairman
Sharon K. Hoobler
Raymond M. Leuthold
Travis W. Manning
Chester O. McCorkle, Jr.
James M. Stepp
Andrew Vanvig

Committee on Retrieval of Agricultural Economics Literature

Fred H. Abel, Chairman
Lee M. Day
Ivan W. Schmedemann
Wolfgang M. Schultz
Arthur W. True

Committee on Review of Postwar Work in Agricultural Economics

Lee R. Martin, Chairman
John P. Doll
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Glenn L. Johnson
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M. Louis Upchurch

Program Committee, Summer Meetings, 1969

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J. C. Headley
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Local Arrangements Committee, Winter 1968

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Joseph Ackerman
Ernest T. Baughman
Raymond O. Gaarder
Leonard J. Haverkamp
Allen O. Johnson
D. Gale Johnson

Local Arrangements Committee, Summer 1969

John C. Redman, Chairman
Loys L. Mather, Employment
Russell H. Brannon, Publicity

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C. E. Bishop, Chairman
J. Carroll Bottum
C. Del Mar Kearl
James Nielson
Harry C. Trelogan

Representative, National Research Council

George E. Brandow

AAEA Consultant to the Bureau of the Census

Joseph Ackerman

Representative, National Bureau of Economic Research

Harold G. Halcrow

Employment Service Study Committee

Richard J. McConnen, Chairman
James Nielson
Max M. Tharp

Committee on Structuring of Student Activities Programs

Neil Harl, Chairman
Raymond R. Beneke
Kenneth B. Boggs

AMENDMENT OF BYLAWS TO PROVIDE FOR STUDENT SECTION

Article XIII

Student Section

Section 1. *Authority for Student Section.* There is hereby created an organization within the Association to be known as the Student Section—American Agricultural Economics Association (hereinafter referred to as the SS-AAEA). The SS-AAEA shall function pursuant to a constitution which shall be developed initially by the SS-AAEA or a committee thereof, approved by a two-thirds vote of the SS-AAEA members present and voting at a meeting of the SS-AAEA at which a quorum is present, and then submitted to the Executive Board of the Association for approval. For purposes of this section, representation from at least twenty percent (20%) of the chartered chapters shall constitute a quorum. Amendments to the constitution of the SS-AAEA shall likewise be submitted to a vote of the members of the SS-AAEA under the voting and quorum rules hereinbefore specified and then submitted to the Executive Board of the Association for approval. The constitution of the SS-AAEA may provide for a statement of purposes, membership rules consistent with the Bylaws of the Association, selection of officers, election of a governing board of not more than seven (7) members in addition to the officers, duties of officers and the governing board, and provisions for meetings, voting (including apportionment of voting rights on the basis of chartered chapters for all matters except for approval of the initial constitution of the SS-AAEA or any amendments thereto which shall require a vote of the members as herein provided) and standing committees. The governing board of the SS-AAEA may develop bylaws containing internal governing rules for the SS-AAEA, which bylaws shall be submitted to the Student Affairs Committee of the Association for approval after the bylaws or amendments thereto have been approved by majority vote of the governing board.

Section 2. *Chartering of local chapters.* Any Department of Agricultural Economics, Department of Economics having programs of undergraduate study in agricultural economics or agricultural business, or any college or university or division thereof having programs of undergraduate study in agricultural economics or agricultural business may make application to the Student Affairs Committee of the Association for the creation of a chapter of the SS-AAEA. Upon making such application, fulfilling requirements imposed by the Student Affairs Committee and paying a charter fee of five dollars ($5), such chapter shall be created by issuance of a charter by the Student Affairs Committee, signed by the chairman of such Committee, the president of the Association, a director of the Association appointed by the president of the Association as a liaison member of the Student Affairs Committee, and the president of the SS-AAEA. Charters shall be issued initially for a term of five years and may be renewed for successive terms of five years each upon filing an application for renewal and payment of a renewal fee of five dollars ($5) for each such renewal. For chapters chartered prior to January 1, 1965, such charters shall be deemed to expire on January 1, 1970, unless application for renewal is filed and renewal fee is paid prior to said date. Payments for original and renewal charter fees shall be made payable to the treasurer of the SS-AAEA and shall be transmitted to the chairman of the Student Affairs Committee who shall, upon approval and issuance of the charter, forward such payments to the treasurer of the SS-AAEA.

Section 3. *Membership.* Any undergraduate student majoring or minoring in agricultural economics, agricultural business, or other curricula within or administered by a Department of Economics or Agricultural Economics in a college or university, or any member of a locally chartered chapter as hereinbefore provided, may become a member of the SS-AAEA. Members of a duly chartered local chapter shall be deemed automatically to be members of the SS-AAEA by virtue of membership in the local chapter. Membership certificates may be purchased by local chapter organizations from the SS-AAEA. An individual who is otherwise qualified for membership but who is not a member of a chartered chapter may become a member of the SS-AAEA by filing application with the treasurer of the SS-AAEA. Membership certificates shall bear the seal of the Association which shall be applied by the chairman of the Student Affairs Committee or his designated representative. Membership in the SS-AAEA shall not be considered a condition precedent to participation in events of the SS-AAEA, nor shall such membership be considered an eligibility requirement for awards given by the Association.

Section 4. *Accountability of funds.* All charter fees and other funds generated by the SS-AAEA shall be made payable to the treasurer of the SS-AAEA and transmitted to the treasurer of the SS-AAEA for redecoration and consolidation, and then forwarded to the treasurer of the Association for credit on the books of account of the Association in such account or accounts in the name of the SS-AAEA as shall be deemed advisable by the treasurer of the Association. The treasurer of the SS-AAEA shall be bonded to an amount of at least two thousand dollars ($2,000) by a general fiduciary bond. All payments from funds of the SS-AAEA shall be by check drawn by the treasurer of the Association as drawer upon request by the treasurer of the SS-AAEA, which request shall be countersigned by the chairman of the Student Affairs Committee of the Association or his designated representative. The SS-AAEA shall prepare a budget each year with the budget submitted to the Student Affairs Committee for approval prior to the beginning of the accounting period involved.

Section 5. *Role and duties of the Student Affairs Committee.* The Student Affairs Committee of the Association shall be responsible for working with and coordinating activities of the SS-AAEA as an integral part of the Association as a professional organization; organizing and conducting suitable and appropriate procedures or contests leading to the selection of recipients for undergraduate debate, undergraduate public speaking and undergraduate essay awards; working with the Awards Committee in presenting such awards; encouraging, supervising and approving the chartering of local chapters of the SS-AAEA; approving bylaws of the governing body of the SS-AAEA and all amendments thereto; approving expenditures from SS-AAEA funds; assisting the officers and governing board of the SS-AAEA in preparation of an annual budget: approving the annual budget of the SS-AAEA; providing advice and counsel to the officers, governing board and committees of the SS-AAEA; communicating with and making recommendations to the Executive Board of the Association regarding the affairs and programs of the SS-AAEA; assisting in program planning for SS-AAEA meetings; facilitating the organization and conduct of regional and national meetings in furtherance of the purposes of the SS-AAEA; and such other duties as the Executive Board of the Association may assign.

FORMAT OF THE 1970 ANNUAL MEETING

Some variations in programming will be tried for the next annual meeting. These will include an effort to utilize more of the self-initiated scholarship that regularly is submitted to *AJAE* as bases for discussions at the annual meeting. The Editor will keep me informed of the flow of manuscripts that have been reviewed and accepted for publication in the JOURNAL. Insofar as these papers offer subject matter that can be integrated into the annual meeting program, I plan to invite the authors to summarize and discuss their papers at the annual meeting. This will apply to papers that have already been published in issues of the JOURNAL preceding the annual meeting and to those accepted for publication in later issues.

To the extent that the thematic design for the annual meeting needs presentation of supplementary topics, I will expect to invite appropriate papers. However, these invited papers will not be automatically published as in the past. Authors of invited papers may, at their option, present manuscripts based on their invited papers for review and possible publication in the JOURNAL in the same manner as others seeking publication in the February, May, August, and November issues.

The proceedings issue (December) will contain abstracts of all papers presented and discussed at the annual meeting, regardless of whether an article has already been published or accepted for publication. As heretofore, the December issue will also contain the Presidential Address, the invited general session papers, committee reports, and Association business.

For the proceedings issue, abstracts can be longer (maximum 250 words) than for regular articles (these are having to be restricted to 100 words to qualify for the *Journal of Economic Literature*).

DALE E. HATHAWAY, *President*

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